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Problems and solutions for organizing public transport in dedicated lanes on urban streets

O.E. Matyaqubov[1][a]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: In both developed and developing countries, increasing the efficiency of public transport and addressing the challenges of passenger transportation are pressing issues. In major cities worldwide, including the United States, Canada, Russia, China, and South Korea, researchers have conducted various studies and initiatives to improve public transport efficiency. As a result, significant progress has been made by implementing dedicated lanes for public transport, which has led to increased transit speeds and reduced route times. However, there are no specific standards or regulations outlining the conditions and scenarios for implementing dedicated lanes for buses. This article focuses on the issues affecting bus operations and their solutions. The research object is the dedicated bus lanes organized in the streets of Tashkent.

Keywords: Dedicated lane, Traffic congestion, Density, Intensity, Traffic flow, Buses, cars, traffic lane

1. Introduction

In today's rapidly developing automotive industry, various types of vehicles are being produced to bring distant places closer to people. This growth not only serves to meet the increasing needs of the population but also leads to a rise in the number of vehicles on the streets, which in turn causes traffic congestion and related issues. As a result, problems related to the disruption of public transport schedules arise. Specifically, public transport (buses) facing such issues leads to significant time and fuel losses and potentially increases the emission of harmful gases into the environment. Preventing and addressing these problems ensures the effective operation of public transport systems in cities. By utilizing international experiences, such as Bus Rapid Transit (BRT), we can address the congestion problems occurring on urban streets in our country.[7] Currently, dedicated lanes for buses are being established on several streets in Tashkent, and research observations are being conducted. Based on the results, the speed of buses operating in dedicated lanes has increased in accordance with their route times. This indicates that implementing and justifying dedicated lanes for public transport plays a crucial role in increasing passenger transport efficiency in cities. Figure 1 illustrates the characteristics of the BRT system [3].

Figure 1: Characteristics of Bus Rapid Transit

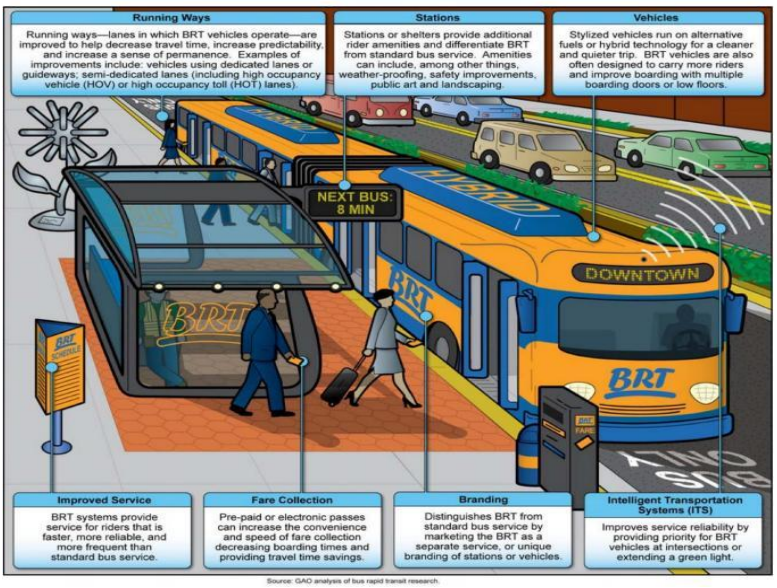

Figure 1. BRT systems are similar to rail systems and are described as follows

[a] https://orcid.org/0000-0002-0183-2111

Bus Rapid Transit (BRT) is an urban transportation system designed to ensure the fast and efficient movement of buses. The system typically utilizes dedicated lanes or busways, pre-scheduled routes, and other advanced infrastructure.[4]

2. Methods and materials

BRT systems generally have the following features:

Dedicated Lanes: Specially designated lanes or busways for buses. This ensures that buses are separated from other vehicles and can move faster.

Fast Payment System: The ability to pay for tickets in advance or before boarding, which speeds up boarding and alighting processes.

Regular Schedule: Buses operate according to a set timetable, allowing passengers to plan their journeys in advance.

Speed and Efficiency: Dedicated lanes and payment systems reduce obstacles in the overall transport system, enabling buses to provide faster and more efficient service. BRT systems are often implemented in large cities or densely populated areas because they offer a fast, reliable, and cost-effective transportation option.

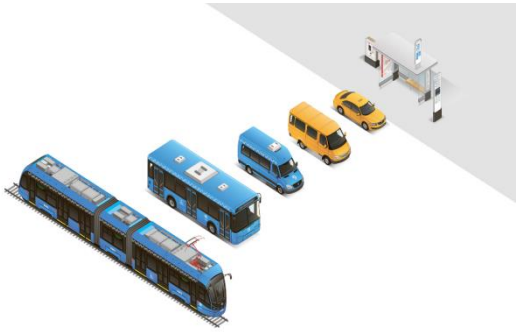

Figure 2. Passenger Transport Vehicles

Passenger transport vehicles come in various types, each designed to meet the transportation needs of different cities or regions. Below is a brief description of the most common types of transport vehicles:[6]

Buses:

City Buses: Serve short distances within the city, typically following designated routes.

Intercity Buses: Operate over longer distances between cities or within a city.

Special Buses: Operate in dedicated lanes as part of BRT systems.[7]

Trolleybuses: Electric buses that receive power via overhead wires, serving short distances within the city.

Trams: Vehicles operating on fixed rails, usually serving short distances within or around a city.

Metros: Rapid transit systems operating on underground or elevated tracks, suitable for large cities, providing fast and efficient transport.

Minibuses: Smaller buses serving short distances within a city or surrounding areas, and often used for informal or specialized services.

Light Rail Transit (LRT): Light rail systems serving short distances within a city or between cities, often operating on dedicated tracks.

Airport Taxis and Shuttle Services: Special taxi and shuttle services that connect airports to city centers or other key locations.

Taxis and Ride-Sharing Services: Services providing private or shared transportation, such as Uber, Lyft, or local taxi services.

Each of these transport modes has its own advantages and limitations, and they work together to improve the efficiency of urban and regional transportation systems.

3. Results and discussions

Challenges and Solutions in Passenger Transport Vehicle Operations:

1. Traffic Congestion:

Problem: Traffic congestion in city centers or major roads leads to slower movement of vehicles, increasing travel times for passengers.

Solutions: Dedicated lanes, BRT systems, and intelligent traffic management systems.

2. Capacity and Speed:

Problem:Delays or deviations from schedules for buses, trams, and other vehicles.

Solutions:Fast payment systems, automated control systems, and schedule adherence monitoring.

3. Safety Issues:

Problem: Safety concerns on buses or other vehicles, including accidents, crimes, or personal safety issues.

Solutions: Implementing robust safety standards, monitoring systems, and hiring security personnel.

4. Comfort and Convenience:

Problem: Lack of comfort or poor condition of vehicles, causing inconvenience to passengers.

Solutions: Introducing new and modern vehicles, improving interior design and ergonomics.

5.Payment Systems:

Problem: Complexity or inefficiency of payment systems causing difficulties for passengers.

Solutions: Adopting new technologies, electronic payment systems, and simplifying payment processes through mobile apps.

6. Service Quality:

Problem: Lack of professionalism in service, low staff qualification.

Solutions:Staff training, developing customer service standards.

7. Environmental Issues:

Problem:Environmental impact of transport vehicles, pollution, and energy efficiency.

Solutions: Introducing electric or hybrid vehicles, using green energy sources.

8. Infrastructure Issues:

Problem: Insufficient or outdated road infrastructure limiting the efficient movement of vehicles.

Solutions: Road repairs, creating new lanes, and modernizing transport infrastructure.

9. Social Issues:

Problem: Transport services not catering to the needs of various social groups, such as a lack of facilities for disabled individuals.

Solutions: Implementing universal design in vehicles, providing special services for disabled passengers.

10. Information Accessibility:

Problem: Lack of or incorrect information for passengers, disrupting travel plans.

Solutions:Improving information provision systems, real-time data delivery, and simplifying user interfaces.

Addressing these problems requires improving and modernizing transport systems. Each issue can be tackled individually or collectively to provide quality and efficient service to passengers.

Challenges in Organizing Bus Movement in Dedicated Lanes:

1. Drawbacks of Dedicated Lanes:

Problem: Dedicated lanes may be underused or obstructed by other vehicles. For example, other vehicles (cars, trucks) may sometimes park or travel in dedicated lanes.

Solutions: Ensuring full lane dedication through strict markings and enforcement, and implementing measures to restrict access to dedicated lanes.

Lane Usability Issues:

Problem: Dedicated lanes may be poorly designed or ineffective, such as inadequate signage or poor condition.

Solutions: Regular maintenance and updating of lane markings, proper signage and indicators.

3. Compatibility Issues:

Problem: Dedicated lanes may not integrate well with other transport systems, reducing the efficiency of the vehicles.

Solutions: Ensuring compatibility with other transport systems, establishing good connections between transport modes.

4. Understanding and Compliance Issues:

Problem: Rules or signs for bus movement in dedicated lanes may be unclear.

Solutions: Making road signs and indicators clearer, preparing bus drivers for operating in dedicated lanes.

5. Demand and Usage Imbalance:

Problem: Dedicated lanes may be underused or experience temporary congestion.

Solutions: Dynamic management of traffic, adjusting routes according to demand, and evaluating the effectiveness of dedicated lanes.

6. Safety Concerns:

Problem: Dedicated lanes might pose safety issues, such as the risk of collisions with other vehicles.

Solutions: Enhancing safety measures in dedicated lanes, installing automatic stop systems, and safety barriers.

7. Construction and Maintenance Issues:**

Problem: Temporary limitations or problems during the construction or maintenance of dedicated lanes.

8.Solutions: Efficient planning of construction and maintenance work, making temporary adjustments to minimize passenger inconvenience.

To resolve these issues, road management and transport organizations need to develop and implement effective strategies, as the successful operation of dedicated lanes helps provide better and higher-quality service to passengers.

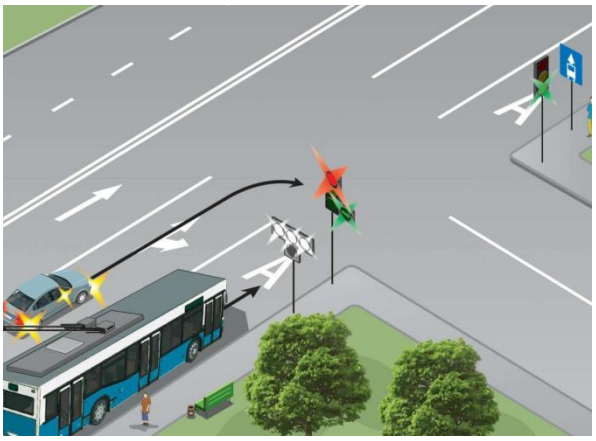

Figure 3. Organizing Bus Movement in Dedicated Lanes

Problems of Bus Movement in Dedicated Lanes:

While organizing buses to move in dedicated lanes (special road lanes) has various advantages, this system can also introduce several problems. Detailed information about these problems and potential solutions is provided below:

1. Poor Maintenance of Road Lanes:

Problem: Dedicated lanes require regular maintenance and good upkeep. If they are not properly maintained, it can reduce the efficiency of buses.

Solutions: Regularly inspect, repair, and maintain dedicated lanes to ensure they are in good condition.

2. Disruption of Dedicated Lanes:

Problem: Other vehicles (e.g., private cars or trucks) may stop or travel in dedicated lanes, causing delays and obstructions for buses.

Solutions: Implement cameras and enforcement measures to monitor lane usage. Introduce specific signage to prevent unauthorized use.

3. Traffic Congestion:

Problem: Congestion or delays can occur within dedicated lanes or at their entry and exit points, leading to delays for buses.

Solutions: Properly plan lane usage and improve the efficiency of traffic management systems.

4. Insufficient Dedicated Lanes:

Problem: Dedicated lanes may be limited in number or only available on certain routes, hindering the efficient service of buses.

Solutions: Expand the network of dedicated lanes and introduce them on more routes.

5. Convenience and Compactness Issues:

Problem: Dedicated lanes often provide limited space, which can complicate interactions with other transport vehicles.

Solutions: Modernize road infrastructure and optimize dedicated lane design.

5. Safety Concerns:

Problem: Safety issues can arise in dedicated lanes, such as the risk of collisions with other vehicles or passenger safety concerns.

Solutions: Ensure proper lane markings, strengthen safety measures, and ensure security within dedicated lanes.

7.Environmental Issues:

Problem: The construction or maintenance of dedicated lanes can lead to environmental issues, such as pollution or resource usage.

Solutions: Use environmentally friendly materials and technologies, and focus on preserving the environment.

9. Implementation Difficulties:

Problem: Difficulties in properly implementing or understanding dedicated lane regulations, such as unclear signage.

Solutions: Make lane markings and indicators clearer, and provide training to bus drivers and passengers.

9. Financial Issues:

Problem: Building, repairing, or maintaining dedicated lanes can be expensive.

Solutions: Reduce inefficient costs and seek additional financial resources from government or private sectors.

Addressing these problems involves developing and implementing effective strategies for road management and transport organizations to ensure the successful operation of dedicated lanes, which contributes to providing better and higher-quality service to passengers.

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4. Conclusion

Addressing the issues related to public transportation operations can enhance the effectiveness of dedicated road lanes and provide better service to passengers. Well-planned and managed dedicated road lanes can significantly improve the overall efficiency of the transportation system. Organizing public transportation in dedicated lanes in city streets involves addressing a range of issues and solutions. These problems and their solutions contribute to the effective management of the transportation system and provide better service to passengers. The organization of public transportation in dedicated lanes is crucial for effective transportation management and delivering quality service to passengers. Dedicated road lanes help reduce congestion, shorten route times, and improve the overall transportation system by ensuring the swift and efficient movement of public transport.

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Information about the authors

Matyaqubov Odilbek Egamberdiyevich	Tashkent state transport university deportment of “Traffic management” PhD researcher. E-mail: encourse1991@gmail.com Tel.:+998933003467 https://orcid.org/0000-0002-0183-2111

The role of commercial banks as investors in the activity of small business subjects

O. Sattorqulov[1][a], S. Raimberdiev[1][b]
[1]Gulistan state university, Syrdarya, Uzbekistan

Abstract: The article shows that the implementation of investment activities of commercial banks in the activities of small business entities is one of the most important financial resources for small business entities, as well as the mechanisms for improving the ways of increasing the role of institutional investors in the commercial banks of Uzbekistan.

Keywords: foreign credit lines, economic instability, limited resources, innovative development, institutional structure, investment activity.

Kichik biznes subyektlari faoliyatida tijorat banklarining investor sifatidagi roli

Sattorqulov O.[1][a], Raimberdiyev S.[1][b]
[1]Guliston davlat universiteti, Sirdaryo, O‘zbekiston

Annotatsiya: Maqolada kichik biznes subyektlari faoliyatida tijorat banklarining investitsion faoliyatini amalga oshirishi kichik biznes subyektlari uchun juda muhim moliyaviy resurlardan ekanligi ko’rsatilgan, shuningdek, O‘zbekiston tijorat banklarida institutsional investor sifatida rolini oshirish yo‘llarini takomillashtirish mexanizmlari ko’rib chiqilgan.

Kalit so‘zlar: xorijiy kredit liniyalari, iqtisodiy nobarqarorlik, resurslar cheklanganligi, innovatsion rivojlanish, institutsional struktura, investitsion faoliyat.

1. Kirish

Bugungi kunda yurtimizda tadbirkorlikning rivojiga katta e’tibor qaratilmoqda. Chunki, mamlakatning iqtisodiy rivojlanishi, oilalar daromadi va ularning farovonligi, yangi ish o‘rinlarining tashkil etilishi aynan ushbu tadbirkorlik rivojiga bog‘liq. Mamlakatimizda tadbirkorlikning jadal sur’atlar bilan rivojlanishida banklarning o‘rni katta, chunki banklar tomonidan tadbirkorlik subyektlariga ajratilayotgan kreditlar orqali iqtisodiy taraqqiyotni ta’minlashning moliyaviy-iqtisodiy-ijtimoiy jihatlari nazarda tutilgan. Ma’lumki, tarmoq kapital taqchilligi sharoitida ko‘p mablag‘ talab etmaydigan xo‘jalik faoliyati sifatida resurslar aylanmasining yuqori sur’atlarini ta’minlaydi, iqtisodiyotni modernizatsiyalash, iqtisodiy nobarqarorlik va resurslar cheklanganligi sharoitida iste’mol bozorini shakllantirish va uni to‘ldirish muammosini tez hamda tejamli tarzda hal etadi.

O’zbekistonda biznes yuritish muhitini yanada yaxshilash, tadbirkorlikka keng erkinliklar berish, kichik biznes subyektlari faoliyatini rivojlantirish va ularni qo’llab-quvvatlash maqsadida qabul qilingan davlat dasturlari asosida banklar tomonidan imtiyozli kreditlar berish orqali hududlarda aholining tadbirkorlik faoliyati bilan shug’ullanishi, uning turmush tarzini yaxshilash, ish bilan bandligini oshirish bilan bir vaqtda tijorat banklari tomonidan ajratilgan moliyaviy resurslarni qaytarilishi va bank moliyaviy xavfsizligini ta’minlashga e’tibor qaratilmoqda.

O‘zbekiston iqtisodiyotini modernizatsiya qilishda xorijiy investitsiyalar alohida rol o‘ynaydi. Xorijiy kredit liniyalari hisobiga investitsiyalar kiritilgan korxonalar innovatsion mahsulotlarni ishlab chiqarish orqali milliy iqtisodiyotimiz samaradorligini oshirayotgan asosiy korxonalardir. Bunday korxonalarda xorijiy kashfiyotlar va nou-xaular o‘zlashtirilmoqda va qo‘llanilmoqda, maxalliy sanoatga chet elning ilg‘or texnologiyalari va asbob-uskunalari jalb qilinmoqda, innovatsion tadbirkorlikning ilg‘or tajribasidan foydalanilmoqda, loyihaviy boshqarish natijadorligi oshmoqda va umuman innovatsiya faoliyati sifati yaxshilanmoqda.

Ichki bozorning ehtiyojlari yuqori sifatli mahsulotlar bilan yanada to‘liqroq qoniqtirilmoqda, mamlakatimiz eksport salohiyati rivojlantirilmoqda va tegishli import o‘rnini bosish ishlari amalga oshirilmoqda. Xorijiy investitsiyalarni faol jalb qilish hukumatimiz tomonidan milliy iqtisodiyotni rivojlantirishning asosiy sharti, sanoat va infratuzilmani Xitoy va boshqa bir qator mamlakatlar tajribasi shuni qo‘rsatmoqdaki, aynan innovatsiyaga yo‘naltirilgan investitsiyalar istiqbolli manba sifatida va mamlakatning zamonaviy rivojlanish parametri sifatida birinchi o‘ringa chiqmoqda.

[a] https://orcid.org/0009-0005-4835-7214
[b] https://orcid.org/0000-0002-0513-9859

Tadbirkorlik subyektlarining uzoq muddatli istiqbolli loyihalarini moliyalashtirish manbalari bo‘lib, bankning o‘z kredit resurslari, xalqaro moliya institutlarining, xususan xususiy sektorni rivojlantirish bo‘yicha Islom korporatsiyasining kredit liniyalari xizmat qiladi. Kelgusi yili bank tomonidan kreditlash jarayonida yangi bank mahsulotlarini va texnologiyalarini eng yaxshi mahalliy va xorijiy tajribalarni hisobga olgan holda yo‘lga qo‘yish bo‘yicha ishlarni davom ettirish rejalashtirilmoqda. Bank investitsiya faoliyatini o‘zining istiqbolli yo‘nalishlardan biri deb hisoblaydi va kelgusida bankning investitsiya qo’yilmalarini ko‘paytirish bo‘yicha bir qancha ishlarni amalga oshirishni, shuningdek investitsiya resurslarining sifatini ko‘tarishni rejalashtirmoqda. Kichik biznes va xususiy tadbirkorlik tashqi bozor konyukturasi o‘zgarishlariga tez moslasha olishi, katta miqdorda mablag‘ talab etmasligi, iqtisodiy faoliyatni muvofiqlashtirishga yo‘naltirilgan qarorlar ijrosining yuqori samarasi, yangi texnika-texnologiyalarni va yangiliklarni o‘zlashtirish darajasining yuqori sur’atlari ta’sirida mehnat unumdorligini oshirib borish imkoniyatlarini yaratib beradi. Kichik biznes faoliyatini moliyalashtirish jarayonida bank kreditlarini ahamiyati beqiyosdir.

2. Metodlar

Tadqiqot jarayonida muammoni atloflicha tahlil qilishda tizimli tahlil, mantiqiy abstraktsiya, tahlil natijalarini tizimlashtirishda induksiya va deduksiya kabi tadqiqot metodlaridan foydalanilgan.

3. Natija va muhokamalar

Bir qator iqtisodchi olimlar tomonidan ushbu mavzu doirasida tadqiqotlar olib borilgan xususan, O.I.Lavrushin o’z tadqiqotlari orqali zamonaviy kredit tizimini shakllantirishda bank tizimini isloh qilish va barqarorligini ta’minlash, banklarning kapitallashuv darajasi va depozit bazasini oshirish, ularning moliyaviy barqarorligi va ishonchliligini mustahkamlash muhim o’rin tutishini ta’kidlaydi[1]. E.P.Jarkovskaya izlanishlarida zamonaviy texnologiya asosida raqobatbardosh mahsulot ishlab chiqarilishini tashkil etishga yo’naltirilgan tijorat banklari investitsiyaviy faolligini kuchaytirish bilan bog’liq jarayonlarga ustuvorlik beriladi[2]. E.F.Jukova tijorat banklari kredit portfelining diversifikatsiya darajasining pasayishini kredit riskining yuzaga keltiruvchi asosiy sabablardan biri sifatida ta’kidlaydi[3]. P.S.Rouz tijorat banklari faoliyatidagi kredit riski darajasini tavsiflovchi muhim ko’rsatkichlardan biri zahira ajratmalari darajasi ko’rsatkichiga e’tibor qaratadi[4]. A.N.Ivanov tijorat banklarining mijozlarini sezilarli qismini to’lovga qobillik darajasining pastligi, asosan, ularning pul oqimining zaifligi bilan izohlaydi. Pul oqimining zaifligi mijozning mutloq likvidlilik koeffitsienti orqali yaqqol namoyon bo’ladi degan xulosaga keladi[5].

Jahonning rivojlangan mamlakatlar tajribasiga muvoffiq kichik biznes va xususiy tadbirkorlik mamlakat iqtisodiyotini barqaror rivojlatirishning asosiy omili hisoblanadi. Jahonda kichik biznes va xususiy tadbirkorlik subyektlari uchun ko’rsatilayotgan bank xizmatlari sifatini oshirish, ularni moliyaviy qo’llab-quvvatlash, kreditlash hajmini kengaytirishga alohida e’tibor qaratilmoqda. Xalqaro moliya korporatsiyasi (IFC) hisobotlariga ko’ra “Jahondagi 65 million kichik biznes subyektlarining 40 foizi har yili 5,2 trillion AQSh dollari miqdorida moliyalashtirilmagan ehtiyojga egaligi, global darajada kichik va o’rta biznesni kreditlash darajasidan 1,4 barobar ko’pdir. Global moliyaviy tafovutning eng katta ulushi, Sharqiy Osiyo va Tinch okeani mintaqasida jami 46 foizni tashkil etsa, Lotin Amerikasi va Karib havzasi mintaqasida 23 foizni, Yevropa va Markaziy Osiyo mintaqasida nisbatan pastroq 15 foizni tashkil etadi”[6].

Kichik biznes subyektlarini rivojlantirishda bank sektorining alohida o’rni bor, chunki aynan banklar kichik biznes subyektlarining iqtisodiy faoliyati samarali kechishi uchun zarur bo’lgan moliyaviy xizmatlarni taklif etadi. Shu o’rinda ta’kidlab o’tmoqchimizki, bank sektori kichik biznes subyektlariga samarali yordam berishi uchun bir qator muammolarni hal etish kerak. Ayni vaqtda kichik biznes subyektlariga, ayniqsa endi faoliyat yuritishni boshlagan tadbirkorlik subyektlariga banklardan uzoq muddatli kredit olish anchagina murakkab, chunki ular olinadigan qarz evaziga garov sifatida taqdim etish uchun yetarlicha bo’lgan mol-mulkka ega emas. Bundan tashqari, kichik biznes subyektlarini moliyalashtirish tijorat banklari uchun tashkiliy xarajatlari yuqori jarayon hisoblanadi.

Mamlakat milliy iqtisodiyotini barqaror va mutanosib rivojlanishi hamda iqtisodiyotning raqobatbardoshligini oshirish yo‘lida va moliyaviy xizmatlar bozorida asosiy tayanch bo‘lgan tijorat banklarining ishtiroki yildan-yilga takomillashib bormoqda. O‘zbekiston Respublikasi davlat iqtisodiy-investitsion siyosatning asosiy maqsadlaridan biri, iqtisodiyotning bank-moliya sohalarida faollikni jonlantirishga yo‘naltiruvchi moliyaviy barqarorlikka va resurs bazasining tobora oshib borishiga erishish hisoblanadi. Bu iqtisodiyotda investitsion jarayonlarining roli va ahamiyatini oshirish bilan bevosita bog‘liqdir. Xususan, milliy iqtisodiyotda tijorat banklarining institutsional investor sifatida rolini oshirish yo‘llarini takomillashtirish xamda raqobatbardoshlik darajasini oshirish masalasiga katta ahamiyat berilmoqda. Ayniqsa, O‘zbekiston milliy iqtisodiyotining bank sektorida institutsional investor sifatida rolini oshirish yo‘llarini takomillashtirish va zamon talabi darajasigacha rivojlantirish dolzarb muammo bo‘lib qolmoqda.

Tijorat banklari tomonidan jamiyat ravnaqi uchun faoliyat yuritayotgan xo‘jalik yurituvchi subyektlar qatorida jismoniy shaxslarga ham ko‘rsatilayotgan xizmatlar salmog‘i ham o‘smoqda. So‘nggi yillarda barcha sohalar kabi axborot-kommunikatsiya tizimining rivojlanishi banklar va bank mijozlariga masofadan turib xizmat ko‘rsatish va onlayn kabi xizmat turlarida yangidan-yangi innovatsiyalarning joriy etilishi bank va bank mijozlari uchun qulaylik tug‘dirmoqda[7].

Tijorat banklari faoliyatida innovatsiyalarni joriy etilishi bevosita bank boshqaruvi xodimlarining tadbirkorlik va tashabbuskorlik faoliyatining mahsuli sifatida yuzaga keladi, bu esa, raqobatbardoshlikka erishishdagi asosiy elementlardan biri hisoblanadi.

Respublika hukumati tomonidan innovatsion g‘oyalar, texnologiya va loyihalarni ishlab chiqish va joriy qilish sohasiga investitsiyalarni keng jalb qilish, ichki va tashqi bozorlarda jamoat va xususiy sektorlardan ilg‘or va ilmiy hajmdor texnologiyalarni faol tarqatish, bozor ishtirokchilari o‘rtasida hamkorlikni kengaytirish, tarmoq korxonalarining jadal rivojlanishiga ko‘maklashadigan mintaqaviy va xalqaro aloqalarni rivojlantirish, ilmiy-tadqiqot

muassasalari, xususiy tadbirkorlik va investorlar o‘rtasida kooperatsion aloqalarni rivojlantirish, yaqin qo‘shnilar bilan ishlab chiqarish aloqalarini tiklash bo‘yicha keng ko‘lamli tadbirlar amalga oshirilmoqda. Bu sohada sifatli xizmat ko‘rsatuvchi malakali kadrlarni tayyorlash va albatta investorlarni hamda iste’molchilarni jalb qilishda innovatsion marketing tadqiqotlari alohida ahamiyatga egadir.

Innovatsion rivojlanishga o‘tish innovatsion salohiyatni jalb qilish va resurslarni optimallashtirishdan ko‘ra ko‘proq iqtisodiyotning institutsional strukturasini tizimli o‘zgartirishni talab qiladi. Shu boisdan milliy iqtisodiyotning innovatsion rivojlanishini to‘xtatib turadigan tendensiyalar namoyon bo‘lishi uning eng muhim yo‘nalishlarini aniqlashda yangicha yondashuvlar ishlab chiqishni talab etadi. Bu ma’noda innovatsion iqtisodiyotning shakllanishi va rivojlanishini institutsionalizatsiyalash ularni bartaraf etishda muhim bir qadamga aylanadi.

Yuqorida bayon qilingan institutsional iqtisodiyot yo‘nalishlari doirasida tavsiflangan bozor o‘zgarishlari jarayonini o‘rganish an’anaviy iqtisodiy tahlil doirasini kengaytiradi va institutsional tizim faoliyati muammolarini tadqiq etishda umumiy nazariy asoslarni hisobga oladigan kompleksli yondashuvdan foydalanish maqsadga muvofiqligini asoslab beradi. O‘ylaymizki, kompleksli institutsional yondashuvning umumiy nazariy metodologik asoslari sifatida faqat har bitta, alohida ko‘rib chiqilayotgan yo‘nalish uchun xos bo‘lgan ma’lum bir jihatlarni ajratib ko‘rsatish lozim. An’anaviy institutsional tahlilda raqobatli muhit shakllantirishning muhim shartlaridan biri sifatida iqtisodiy subyektlarga huquqlar berish va cheklovlar shakli sifatida institut (muassasa) tushunchasini ajratib ko‘rsatamiz. Yangi institutsional iqtisodiyotga xos bo‘lgan jihatlar rasmiy va norasmiy qoidalar, shartnoma tizimi tahlili, institutsional tuzilma va tashkilot shakllarini tadqiq etish hisoblanadi.

O‘zbekistonda banklarga institutsional sarmoyadorlarning, ya’ni o‘z ish faoliyatining xususiyatiga ko‘ra doimiy va katta miqdordagi pul mablag‘lariga ega bo‘lgan hamda ularni qimmatli qog‘ozlar portfeliga qo‘yilma qilishga ruxsat berilgan.

Banklar institutsional sarmoyadorlarining aksiyalarini sotib olib, pul mablag‘larini jamg‘arish uchun qo‘shimcha imkoniyaga ega bo‘ladi, shuningdek, mijozlarning qimmatli qog‘ozlar portfelini boshqarish bo‘yicha o‘z operatsiyalarini kengaytiradi. Banklar xususiylashtirilayotgan va qayta tashkil etilayotgan korxonalarning qimmatli qog‘ozlarini katta xajmda investitsiya qilishga qodir bo‘lgan yirik institutsional investorlari bo‘lib hisoblanadi[8].

Mustaqillik yillarida mamlakatimizda bank tizimi rivojiga qaratilgan tub o‘zgarishlar o‘zining kutilgan samarasini bermoqda. Bugungi kunda banklar tadbirkorlar bilan nafaqat mijoz, balki yaqin hamkor, hammaslak sifatida mustahkam aloqa o‘rnatgan. O‘z biznesini yo‘lga qo‘yish istagida bo‘lgan ishbilarmonlarga banklar katta ko‘mak bermoqda. Bir so‘z bilan aytganda, aholi ishonchini qozonadigan, keng qamrovli moliyaviy xizmatlarni ko‘rsata oladigan bank tizimi shakllandi. Bu natijalar bank xizmatlari va mahsulotlari turlari tobora kengayib borayotganida, ishbilarmonlik muhiti tobora yaxshilanib, banklar tomonidan ajratilayotgan kreditlar hajmi o‘sayotganida aks etmoqda (1-jadval).

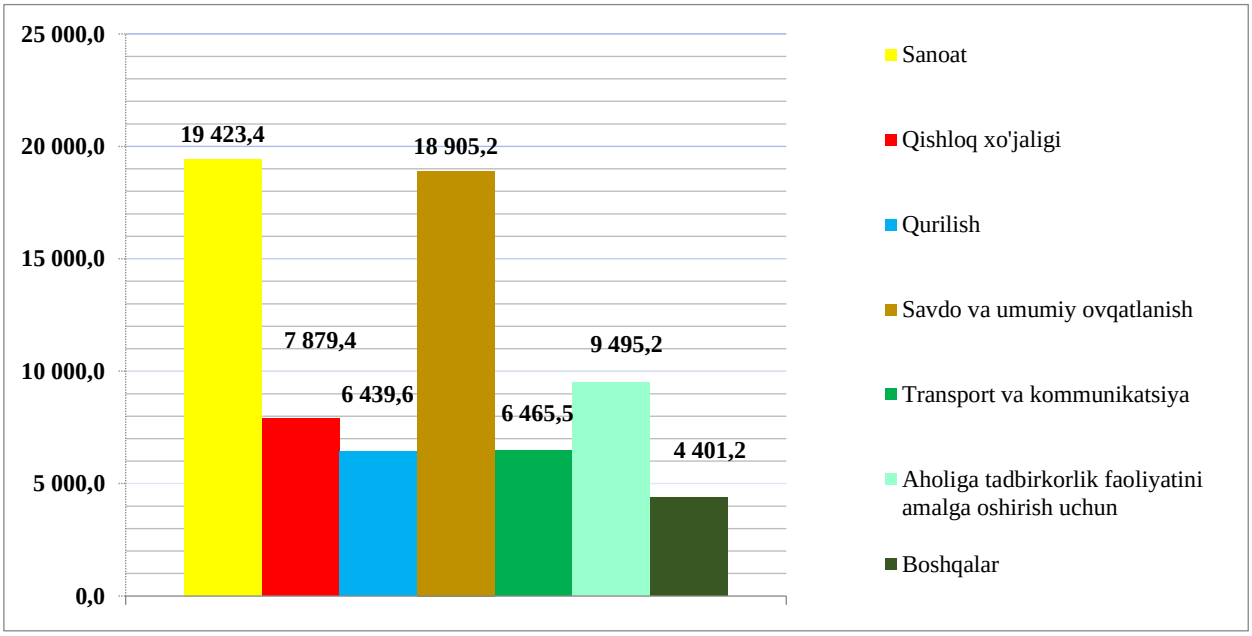
1-jadval

Kichik va o’rta tadbirkorlik subyektlariga hamda aholiga tadbirkorlik faoliyatini amalga oshirish uchun ajratilgan kreditlar (mlrd. so’mda)[9]

Davr	Ajratilgan kreditlar		shundan:					
			yuridik shaxslarga		yakka tartibdagi tadbirkorlarga		aholiga tadbirkorlik faoliyatini amalga oshirish uchun	
	soni	summasi	soni	summasi	soni	summa	soni	summasi
2023 yil	**573 252**	**73 009,4**	**78 620**	**57 438,1**	**24 553**	**6 076,2**	**470 079**	**9 495,2**
Yanvar	9 168	4 120,7	6 126	3 847,2	1 140	235,9	1 902	37,6
Fevral	28 971	5 154,5	8 932	4 449,9	592	291,3	19 447	413,4
Mart	59 811	7 354,3	6 508	5 753,1	2 337	524,9	50 966	1 076,4
Aprel	61 500	5 104,0	6 033	3 544,1	2 311	504,3	53 156	1 055,6
May	81 004	7 321,0	5 666	5 267,9	2 545	604,6	72 793	1 448,5
Iyun	54 695	6 489,2	4 521	5 004,2	1 585	528,0	48 589	957,0
Iyul	48 060	5 980,9	5 304	4 682,4	1 961	497,4	40 795	801,1

Avgust	48 837	6 201,6	6 525	4 988,4	2 039	424,2	40 273	789,1
Sentyabr	40 938	7 310,9	4 778	5 804,3	2 119	817,6	34 041	689,0
Oktyabr	52 383	6 651,2	7 732	5 319,2	2 113	463,1	42 538	868,9
Noyabr	45 977	5 483,1	7 551	4 206,7	2 503	552,6	35 923	723,7
Dekabr	41 908	5 838,1	8 944	4 570,6	3 308	632,4	29 656	635,1

Yuqoridagi jadval ma'lumotlaridan ko'rishimiz mumkinki o'tgan 2023-yilda tijorat banklari tomonidan aholiga tadbirkorlik faoliyatini amalga oshirish uchun umumiy miqdorda 9 495,2 mlrd.so'm miqdoridagi 470 079 ta kredit ajratilgan.



1-rasm. Kichik tadbirkorlik subyektlariga hamda aholiga tadbirkorlik faoliyatini amalga oshirish maqsadlari uchun 2023-yilda ajratilgan kreditlar (tarmoqlar bo'yicha, mlrd.so'mda)[9].

* Markaziy bank statistik byulleteni ma'lumotlari asosida muallif tomonidan tayyorlandi.

1. -rasmga ko'ra tijorat banklari tomonidan 2023-yilda ajratilgan kreditlarning eng katta qismi 19 423,4 mlrd.so'm yoki 26,6 foizi sanoatga to'g'ri keladi. Undan keyingi o'rinlarda 25,9 foiz bilan savdo va umumiy ovqatlanish uchun ajratilga va 8,9 foiz bilan aholiga tadbirkorlik faoliyatini amalga oshirish uchun ajratilgan kreditlar hissasiga to'g'ri kelmoqda.

Hozirda amaldagi qonunchilik tijorat banklarining rivojlanishiga katta imkoniyatlar yaratadi. Biroq, ushbu imkoniyatlar bank boshqaruv tizimi tomonidan to'liq ishga solinmay qolmoqda. Tijorat banklarida institutsional investor sifatida rolini oshirish yo'llarini shakllantirishning institutsional mexanizmlarini mustaxkamlanishi lozim. O'zbekistonda xorjiy investitsiyalar hajmi oxirgi 5 yilda muntazam o'sib kelmoqda, bunga asosiy sabab esa xorijiy investorlar uchun yaratilayotgan qulay sharoit va investitsion muhitdir.

Kichik biznes subyektlarini kreditlashga e'tibor qaratayotgan banklar ijobiy kredit tarixiga ega korxonalarni tanlashadi. Shunday bo'lsa ham banklar kreditlash jarayonida riskka qo'l urishadi, chunki korxonaning haqiqiy moliyaviy holatini kuzatish har doim ham mumkin emas. Bu, asosan, ko'plab korxonalar biznesining ancha yuqori ulushi (taxminan 30-50%) xufyona iqtisodiyot sektorida qolayotganligi bilan bog'liq. Aynan shu qismini bank hech qanday tarzda nazorat qila olmaydi, buning natijasida muammolar paydo bo'ladi. Kichik biznesni kreditlashda yana bir dolzarb muammo - bu kichik biznes uchun tijorat ko'chmas mulki ko'rinishidagi yuqori likvidli garov ta'minotining yo'qligi, chunki banklar mijozlarga berilgan kreditlar, ayniqsa, ular uchun yetarlicha ta'minlanmagan hollarda, kredit summasining yuz foizi miqdorida zaxiralar yaratishga majbur. Bunday vaziyatda bank tomonidan beriladigan kreditlar bankning moliyaviy xavfsizligiga bevosita ta'sir qiladi. Tijorat banklari amaliyotida kichik biznes subyektlarini kreditlash sifatini oshirishga qaratilgan chora-tadbirlar majmui sifatida quyidagilarni ko'rsatishimiz mumkin:

- banklarning kredit portfelida mavjud kreditlarga nisbatan stresstest amaliyotini qo'llash imkoniyatlarini oshirish;
- kreditlarni tasniflash kesimida batafsil tahlil qilib,

kredit portfeli sifatini saqlab qolish bo'yicha ta'sirchan, mukammal mexanizmlarni ishlab chiqish va amaliyotda qo'llash;

- tijorat banklari kredit portfellari mukammal nazoratdan o'tkazilib, qiyin ahvolga tushib qolgan har bir mijozning moliyaviy imkoniyatlarini tiklash bo'yicha aniq choralarni ishlab chiqish hamda uning moliyaviy holatini o'rganish asosida mukammal baho berish zarurligi shular jumlasidandir.

Tijorat banklari kichik biznes subyektlarini moliyalashtirish jarayonida kredit operatsiyalarini amalga oshirishga doir quyidagi muammolar mavjud va ularga qarshi kurashish tizimini yaratish orqali moliyaviy xavfsizligini ta'minlash mumkin[10]:

1. Hozirda tijorat banklari kreditlash vaqtida kredit ta'minoti sifatida qabul qilinadigan garov mulkini mavjud qonunchilikka asosan kredit muddatiga teng muddatga sug'urta qilinishi lozim. Banklar kredit ajratish jarayonida mijozlarning kredit ta'minoti sifatida taqdim qilgan garov mulkini sug'urtalashda mijozlar tomonidan sug'urta korxonalariga to'lanadigan summani kamaytirish orqali aholi va tadbirkorlik subyektlari mablag'larni o'zlarida qoldirish mumkin. Buning natijasida bank mijozlarining qo'shimcha mablag'larga bo'lgan ehtiyojlari kamayadi va bu to'g'ridan - to'g'ri kredit talabini kamayishiga imkoniyat yaratadi.

2. Respublikamiz tijorat banklari aholi va tadbirkorlik subyektlariga qo'llab quvvatlab, ajratayotgan kreditlar xususan, imtiyozli kreditlari hajmi juda katta sur'atlarda ortib borishiga qaramasdan, ushbu jarayonda faol qatnashayotgan tijorat banklarini hukumat tomonidan imtiyozlar berish mexanizmi joriy qilinmagan.

3. Muammoli kreditlarni iloji boricha kamaytirish uchun avvalo kreditlarni skoring qilishni mamlakatimiz barcha banklarida (hozirda ba'zi banklar foydalanadi) joriy qilish, bunda faqatgina mijoz faktorini xisobga olmasdan inson omolini qo'shishimiz zarur. Bundan tashqari hozirda "garov reestri"ga faqatgina garovlarni registratsiya qilmasdan kafilliklarni ham qo'shish lozim.

Kichik biznes subyektlarini kreditlash jarayonida tijorat banklari o'z moliyaviy xavfsizligini ta'minlash jarayonida kreditga layoqatlilik holatini o'rganishi zarur.

4. Xulosa

Xulosa qilib aytganda, tijorat banklari orqali kichik biznes va xususiy tadbirkorlik subyektlari uchun bank tizimining samarali faoliyat yuritishini ta'minlash nafaqat ichki o'zini o'zi tartibga soluvchi mexanizmlar, balki bank nazoratining ilg'or tizimi orqali amalga oshirilishi jahondagi rivojlangan mamlakatlar tajribasidan ma'lum. Ta'kidlab o'tish kerakki, bozor iqtisodiyotida bank nazorati rejali iqtisodiyotga xos nazorat va taftish tizimidan tubdan farq qiladi.

Tahlillar shuni ko'rsatadiki, milliy iqtisodiyotda tijorat banklarining institutsional investor sifatida rolini oshirish yo'llarini takomillashtirishda kichik biznes faoliyatini tashkil qilishning institutsional asosini takomillashtirish hamda rivojlantirishning xorij tajribasi asosida integratsiyalashgan — innovatsion hamkorlik imkoniyatlaridan samarali foydalanish, yirik ishlab chiqarish korxonalari va kichik biznes muhitiga ta'sir etuvchi — global va lokal hamda bevosita va bilvosita omillar ta'siri doirasida integratsiyalashgan o'zaro iqtisodiy aloqalar mexanizmini tashkil qilish maqsadga muvofiqdir. Shuning uchun, O'zbekiston tijorat banklarida institutsional investor sifatida rolini oshirish yo'llarini takomillashtirish mexanizmlarini institutsional mustahkamlash uchun quyidagilar taklif qilinadi :

1. Tijorat banklari boshqaruv organlari samaradorligini baholash tizimini ishlab chiqish va maxsus baholov komissiyasi ishini tashkil qilish.

2.Tijorat banki boshqaruv organlari samaradorligini baholash bo'yicha baholov komissiyasi tarkibini faqat kompaniyada ishlamaydigan autsayder va minoritar aksiyadorlardan tayinlash.

3. Milliy iqtisodiyotda tijorat banklarining institutsional investor sifatida rolini oshirish va mexanizmini yaratish orqali bank biznes rejasining ijro intizomini ta'minlash va bank kengashida maxsus qo'mita tashkil qilish.

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Mualliflar to'g'risida ma'lumot/ Information about the authors

Sattorkulov Obidkul Tudikulovich	I.f.n, dotsent, Guliston davlat universiteti https://orcid.org/0009-0005-4835-7214
Raimberdiev Samandar Sherzod o'g'li	Guliston davlat universiteti magistri https://orcid.org/0000-0002-0513-9859 Tel.: (+99891)-5069012 E-mail: samandarsherzodovich@gmail.com

Asymmetric modes in transport

R. Abdullaeva[1][a], K. Turdibekov[1], A. Sotvoldiyev[1]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: As the voltage increases, losses in the steel of power transformers increase, which leads to an increase in the temperature of the steel. With an increase in voltage, the generation of reactive power by overhead power lines and batteries of static capacitors increases, which can lead to large voltage rises in the network and the danger of breakdown of the insulation of electrical equipment. The listed harmful effects of voltage deviations in the network from the nominal values require measures to regulate the voltage in the network.

Keywords: asymmetric, technical, symmetrical, multifunctional.

1. Introduction

Asymmetric modes can be long-term and short-term. Short-term asymmetric modes are associated with emergency processes, long-term ones are due to the presence of asymmetry in the elements of the electrical network.

The reasons for the asymmetry may be:

-asymmetry of current sources;

-incomplete-phase modes of electrical network elements;

-electric receivers with different loads in phases.

It should be noted that the development of industrial and municipal energy is characterized by an increase in the number and capacity of electrical installations with an asymmetric load, which worsens the operation of other electrical receivers[1]. The asymmetry can be longitudinal, associated with phase-by-phase disconnection of lines and transformers, and transverse, due to phase load asymmetry.

2. Materials and methods

Usually these are electric receivers, the manufacture of which in three-phase design is irrational according to technical and economic indicators. These include induction electric furnaces, electrified alternating current transport, utility loads, single-phase motors in agriculture. Electrical networks of power supply systems, depending on the class of rated voltage, have different designs and, accordingly, react differently to load asymmetry.

Electrical networks of power supply systems for industrial, municipal and agricultural consumers at a voltage of up to 1000 V are three- and four-wire [2]. The operating modes of such networks are the same under symmetrical load, and different under asymmetric load.

Voltage symmetry in power supply systems

To reduce the effect of voltage asymmetry, voltage symmetry is performed, while special additional balancing devices are used only in cases where the following measures are insufficient:

-connection of unbalanced loads on network sections with the highest possible power efficiency;

-allocation of asymmetric loads of significant power to individual transformers;

-uniform distribution of single-phase loads across all phases. Phase-by-phase load redistribution does not always ensure that-

-stress symmetry within acceptable limits. This is due to the fact that a number of electrothermal installations are not constantly in operation according to the conditions of technology and operation [7].

If there is an asymmetry (more than 2%) and other measures have been exhausted, a decision is made to balance the load with additional devices. A symmetrical device solves two problems at once:

-load balancing;

-reactive power compensation.

Asymmetric modes are characterized by the presence of component currents and voltages of the reverse and zero sequences, which lead to the following adverse consequences:

1. There is a danger of overloading three-phase electric motors with reverse currents. Synchronous and asynchronous motors have low reverse sequence resistance [6]. Even small reverse sequence voltages in SES can cause significant reverse sequence currents in motors, which, superimposed on direct sequence currents, cause current overload of individual phases of the engine and, consequently, additional heating of the stator and rotor, which leads to accelerated aging of insulation and a decrease in available engine power[3].

2. Additional losses of active power and electrical energy appear due to the flow of reverse and zero sequence currents in SES elements up to 1 kV.

Incomplete-phase modes in SES are one of the varieties of emergency modes. The most common non-phase modes occur in electrical networks protected by fuses (in case of fuse box burnout in one of the phases). However, in the practice of SES operation, other cases have occurred (breakage of the phase wire in the loop of the anchor support of overhead power lines, loss of electrical contact in one of the phases of the cable or wire, and a number of others). An unfavorable feature of incomplete-phase modes is that they are usually not detected by conventional types of relay protections (maximum current, minimum voltage) and, therefore, can exist for a long time. The incomplete-phase mode, as an asymmetric one, is characterized by the presence of significant components of currents and voltages in the reverse sequence. AC electric motors have low reverse

[a] https://orcid.org/0009-0001-5364-9335

sequence resistance and are loaded with reverse sequence currents in non-phase modes. In many cases, protection against overload of motors from incomplete-phase modes turns out to be ineffective and due to thermal effects caused by reverse currents, massive damage to electric motors is possible.

Distorting power flows reflect the power losses in the SES elements from the flow of currents of the corresponding sequences. The greatest distorting power and voltage flows of individual sequences occur at the terminals of an asymmetric load and decrease as they move away from it. The significant spread of asymmetric loads leads to significant violations of the symmetry of currents and voltages in three-phase electrical networks, especially distribution networks. The consequence of the phase asymmetry of currents is the "skew" of the secondary voltage star of distribution transformers and the occurrence of additional losses in the modes of an asymmetric phase load.

Additional tasks arise under operating conditions. Systematic monitoring of asymmetry indicators in industrial networks is required (as a rule, this control should be statistical). For the full use of additional balancing devices and comprehensive technical and v of the current regime, special training of operational personnel should be carried out. Specific decisions have already been made for a number of installations. Individual single-phase electrothermal installations are equipped with special balancing devices.

The reliability of the research results is confirmed by the following: the correctness of the initial assumptions; the correct use of proven mathematical models of SES elements up to 1 kV; a good coincidence of the results of computational and experimental studies with various observational data on the consequences of real asymmetric and incomplete phase modes in SES up to 1 kV; a good explanation of the results of computational experimental studies by the physics of non-symmetric modes.

The most time-consuming and responsible stage of computational research is the preparation and loading of initial data. Previously, it is necessary to mark up the SES circuit by numbering the elements of the electrical network, the nodes of the replacement circuit, load nodes, switches, synchronous and asynchronous motors of the SES. In addition to the numbers, symbolic (letter) designations are provided for the elements of the electrical network and load nodes, which make it easy to identify the necessary network elements and load nodes in the printouts of the calculation results. Uploading the source data about the FEZ to the files .DAT and VOL.DAT is carried out according to a special program for the preparation of initial data. The load node simulates a section of a switchgear to which an arbitrary number of synchronous and asynchronous motors are connected, as well as a three-phase symmetrical other load set by active and reactive power. The absence of any of the loads in the node is reflected by setting zero values of the corresponding capacities.

Algorithms have been developed for calculating the mode for the components of the reverse and zero sequences in the incomplete phase mode of SES up to 1 kV by converting the EMF sources of the reverse and zero sequence at the point of phase interruption into two additional sources of nodal currents for the components of the reverse and zero sequences. The algorithms are based on the nodal stress method.

For four-wire electrical networks, transformers with circuits for connecting windings Y/Un, D/Un, Y/ZH can be used. Transformers with a Y/YH connection scheme, the simplest in design and cost-effective in terms of material consumption, are still not widely used due to the high resistance of the zero sequence. The A/YH connection scheme is more preferable. The lowest resistance of the zero sequence can be obtained at Y/ZH, however, the transformer windings are switched on according to this scheme at a transformer power of 250 kVA or lower. The considered power supply schemes (Fig. 3.1-3.6) with a transformer capacity of 1600 kVA, which excludes the possibility of conducting computational and experimental studies using the Y/ZH connection scheme.

Based on the patterns of distribution of reverse and zero-sequence currents caused by an asymmetric load across the elements of the SES, it can be assumed that the main factor determining the range of permissible asymmetric loads is the nature of the electrical load in the SES up to 1 kV. This is explained by the fact that the motor load has a reverse sequence resistance 5-7 times less than the resistance of the direct sequence, while the non-motor (static) load (according to accepted terminology - other, S^) has a reverse sequence resistance commensurate with the resistance of the direct sequence. The electric motor load accumulates currents of the reverse sequence, reduces the total resistance of the reverse sequence of the SES and, thereby, reduces the voltage of the reverse sequence with an asymmetric load.

3. Results and explanations

The maximum permissible single-phase load for the zero sequence voltage is on average from 1.3 to 23% of the rated power of the supply transformer, and this is almost ten times less than for the reverse sequence voltage [5].

Since the voltage of the zero sequence does not affect the operation of three-phase consumers, and for single-phase consumers, voltage deviation standards must be met regardless of voltage asymmetry, it is appropriate to raise the question of eliminating the normalization of the voltage of the zero sequence. The range of permissible modes of single-phase zero-sequence load depends on the wiring diagram of the transformer windings of the workshop substation, on the remoteness of the connection point of the asymmetric load and the cross section of the zero core of the supply cable.

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Information about the authors

Abdullaeva Ruxsora Sobirovna	Toshkent davlat transport universiteti “Elektr ta’minoti” kafedrasi doktaranti. E-mail: rabdullayeva896@list.ru Tel:+99894-220-00-57 https://orcid.org/0009-0001-5364-9335
Turdibekov Kamol Khamidovich	Toshkent davlat transport universiteti “Elektr ta’minoti” kafedrasi dotsenti. E-mail: kamalbek.turdibekov1945@mail.ru Tel: +998-90-168-51-45
Sotvoldiyev Abduvohid Ro‘ziboy o‘g‘li	Toshkent davlat transport universiteti TYTM fakulteti dekan o‘rinbosari E-mail: abduvoxid.sotvoldiyev@mail.ru Tel: +998-91-134-60-03

Prospects for metropolitan development

S.T. Norkulov[1][a]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: After gaining independence, Uzbekistan chose a unique and suitable path of development and renewal in the economic, socio-political, ideological and spiritual spheres. Sustainable development of the country's economy, achieving sustainable economic growth rates, ensuring the competitiveness of our national products on the world market, improving the standard of living and well-being of our people are among the most important tasks today.

Keywords: Subway, tunnels, station, complex

Metropoliten taraqqiyoti istiqbollari

Norkulov S.T.[1][a]
[1]Toshkent davlat transport universiteti, Toshkent, O'zbekiston

Annotatsiya: O'zbekiston mustaqillikka erishganidan so'ng iqtisodiy, ijtimoiy-siyosiy, mafkuraviy-ma'naviy sohalarda taraqqiyot va yangilanishning o'ziga xos hamda o'ziga mos yo'lini tanladi. Mamlakat iqtisodiyotini barqaror rivojlantirish, barqaror iqtisodiy o'sish sur'atlariga erishish, jahon bozorida milliy mahsulotlarimizning raqobatbardoshligini ta'minlash, xalqimizning hayot darajasi va farovonligini oshirish bugungi kundagi eng ustuvor vazifalardan hisoblanadi.

Kalit so'zlar: Metro, tonnellar, bekat, majmua

1. Kirish

Toshkentning qariyb 100 yildan ortiq transport tarixiga nazar tashlasangiz, qanchadan qancha ulov turlari paydo bo'lib, yo'qolib borganini ko'rasiz.

Ammo metro hatto osmonda uchadigan mashinalar o'ylab topilgan taqdirda ham o'z ahamiyatini yo'qotmaydigan jamoatchilik transporti bo'lib qolaveradi. Shu sababli Toshkent shahri, umuman, davlatimiz rahbariyati rejalarida metro yo'nalishlarini uzaytirish, bu transport turini muttasil rivojlantirib borish doim eng e'tiborli vazifalar qatorida turadi.

Bizda metro qurish hali uzoq yillar uzluksiz davom etadigan jarayondir. Toshkent metropolitenining istiqboli juda porloq.

Kelajakda metro hozir biz bilgan klassik shakldan o'zgacharoq bo'lishi kutilyapti. Endi uni boshqa transport turlari bilan omixta qilish, nafaqat yer osti, balki yer usti transportiga ham aylantirish g'oyalari mavjud. Tobora kengayib, aholisi va ulovlari ortib borayotgan Toshkent transport tirbandligi degan muammoga duch kelmoqda. Avtomobil tirbandligi katta iqtisodiy va ijtimoiy zararlarga olib kelishi mumkin bo'lgan muammodir. Uni hal etish uchun turli ko'priklar, yo'l o'tkazgichlari, yangi yo'llar qurilyapti, shahar qiyofasi ham tobora o'zgarib boryapti. Toshkent bo'yiga o'syapti. 2016 yil 21 oktyabr kuni O'zbekiston Respublikasi Prezidentining "Toshkent metropolitenini yanada rivojlantirish va samaradorligini oshirish chora tadbirlari to'g'risida"gi PQ-2638-sonli farmoni e'lon qilindi. Ushbu farmonning o'z vaqtida va samarali amalga oshirilishini ta'minlash maqsadida 2016 yil 21 noyabr kuni "O'zbekiston temir yo'llari" AK boshqaruv raisi A.J.Ramatovning "Toshkent metropoliteni qurilishi direksiyasini tashkil etish to'g'risida"gi 484-N sonli buyrug'i chiqdi. Ayni kunlarda Toshkent metropolitenining yangi navbatlari qurilish ishlari jadal sur'atlarda olib borilyapti.

2. Tadqiqot metodologiyasi

2017 yilning o'zida Sergeli yo'nalishi bo'yicha 4,5 kilometr estakada qismini barpo etish rejalashtirilgan. Bugungi kunda bu yerda 200 dan ziyod quruvchi, mutaxassis mehnat qilyapti. 300 dan ziyod maxsus texnika vositalari jalb etilgan. Yunusobod yo'nalishida ham qurilish- montaj ishlari avj pallada. Bu yo'nalish qurilish ishlariga 75 ga yaqin texnika hamda 180 dan ziyod malakali mutaxassis hamda ishchi-xizmatchilar jalb etilgan.

[a] https://orcid.org/0000-0001-8047-0835




Har qanday metro qurilishi avvalo loyihadan boshlanadi. O‘tgan asrning 70 yillarida Toshkent metropoliteni qurilishi uchun ilk amaliy qadam «Toshmetroproekt» institutining tashkil etilishi bilan qo‘yilgan edi. 1972 yil «Metrogiprotrans» institutining filiali sifatida tashkil etilgan ushbu tashkilotga mamlakat hududida metropoliten, tonnellar va turli xarakterdagi yerosti inshootlarini loyihalash vazifasi topshirilgan edi.

Toshkentda metro noldan boshlangan, O‘zbekistonda na uni qurish tajribasi, na ilmiy texnik baza mavjud edi. Hamma tashkiliy masalalar institutning birinchi direktori Masar Xolmurodovich zimmasiga tushdi. U respublika va shahar rahbariyatining ko‘magi bilan maslakdoshlar jamoasini tuzdi va ishni yo‘lga qo‘ydi. Shuningdek, qator shogirdlarni tarbiyalab O‘zbekistonda metroni loyihalash maktabiga asos soldi.

Keyinchalik «Tashkent Metroproekt» MCHJ sifatida faoliyat yurita boshlagan tashkilot Toshkent metropolitening hozirda mavjud har uchala yo‘nalishi loyihasini ishlab chiqqan. Shuningdek, u ko‘priklar, avtoyo‘l tonnellari, transport chorrahalari va boshqa yerosti hamda yer usti inshootlarini loyihalashtirib kelmoqda. Tashkilotda 20 yil va undan ortiq mehnat tajribasiga ega yuqori malakali mutaxassislar faoliyat yuritib kelmoqda. Ular sohaning o‘ziga xosligi va hamma ikir-chikirlarini yaxshi biladilar, murakkab muhandislik, geologik, seysmik, gidrologik masalalarni yechishga qodir, shaharsozlik borasida benazir malaka va tajribaga ega kadrlardir.

«Tashkent Metroproekt» MCHJ ishtirokida Olmota shahri metropolitenining birinchi va ikkinchi bosqichi, Moskva metrosining Butov yo‘nalishi, Strogin Mitin yo‘nalishining tonnel-oldi inshootlari loyihalandi va boshqa qator xalqaro loyihalar amalga oshirildi.

O.Zokirov, bosh direktor A.Zokirov, bosh direktor o‘rinbosari M.Xodjayev rahbarligida bosh muhandis V.Bensler, bosh arxitektor T.Nurullin kabi yetuk mutaxassislardan tarkib topgan «Tashkent Metroproekt» MCHJning ahil jamoasi Yunusobod yo‘nalishining ikkinchi bosqich qurilishida asosiy loyihachi sifatida loyihalash ishlarini jadal olib bormoqda. Shuningdek, Sergeli yo‘nalishi loyihalash ishlarida ham qatnashmoqda. Bundan tashqari «Tashkent Metroproekt» MCHJ Toshkent metropolitenining taraqqiyoti konsepsiyasini ishlab chiqishda ishtirok etmoqda. So‘nggi yillarda yo‘llarni kengaytirish, avtomobil tirbandligini kamaytirish maqsadida shahar tramvay va trolleybusdan voz kechdi. Poytaxtdagi barcha tramvay yo‘llari demontaj qilindi, trolleybus simlari olib tashlandi. Endi jamoatchilik transporti sifatida faqat avtobuslar va metro qoldi. Bu ularga tushadigan yuklamaning ortishiga sabab bo‘ldi. «Toshkent metropoliteni» esa metro yo‘nalishlarini uzaytirish orqali muammoga yechim topmoqda. Bundan tashqari shaharda taksi tarmoqlari ham rivojlanyapti. Faqat metroning avtobusdan va yengil avtomobillardan katta afzalligi bor: u ekologik toza transport. Shahar avtoulovlardan chiqayotgan gazlar bilan 70 foizgacha zaharlanayotgan bir davrda metroning ahamiyati haqida ko‘p gapirish shart emas.

Toshkentda metropoliten taraqqiyoti shaharning bosh rejasi va metro yo‘nalishlarining bosh sxemasi asosida amalga oshiriladi. Yo‘nalishlar esa aholi yashash hududlari, ishlab chiqarish korxonalari, o‘quv muassasalari, idoralar, dam olish maskanlari va shu kabi odam ko‘p to‘planadigan joylarni inobatga olgan holda loyihalanadi.

Bosh loyihaga asosan Toshkent metropoliteni yo‘nalishlari yanada uzayib boraveradi. «Chilonzor» yo‘liga «Buyuk ipak yo‘li»dan so‘ng yana 3 ta bekat qo‘shiladi va u Toshkent Traktor zavodiga qadar boradi. Mazkur yo‘lning uzunligi 16,2 km dan 20,6 km gacha uzayadi va shahar chekkasigacha – Qorasuv mavzesigacha yetadi. Janubi-g‘arbiy tomondan uni «Olmazor» bekatidan «Otchopar» bozorigacha, hatto «O‘rikzor» mavzesigacha yetkazish mumkin.

O‘zbekiston yo‘lini janubi-sharqiy yo‘nalish bo‘ylab «Qo‘yliq» mavzesigacha, Shimoliy-g‘arbiy tomondan esa Qoraqamish mavzesigacha uzaytirish rejasi bor. Yunusobod yo‘li ham shimol tomondan shahar tashqarisigacha boradi. Hozir mavjud olti bekatga yana ikkitasi qo‘shiladi: «Yunusobod», «Turkiston». Janubiy tomondan esa yana to‘rt bekat quriladi: «Bobur», «To‘qimachi», «Usmon Nosir», «Janubiy». Yo‘nalishlar uzayib, bekatlar ko‘payishi barobarida, ularning kesishuv nuqtalari ham ko‘payadi. Bu esa, o‘z navbatida, yangi qulayliklarni keltirib chiqaradi.

yo‘lovchilarning manzilga yetib borish vaqtlarini tejaydi, uzoqni yaqin qiladi.

3. Natija va muhokamalar

Statistik ma’lumotlarga ko‘ra, so‘nggi vaqtlarda metroda yo‘lovchilar kamayishi kuzatilmoqda. Bu yengil avtomobillar soni ortgani, taksi xizmatining shaharning istalgan nuqtasigacha eltish imkoniyati bilan izohlanyapti. Ammo metro ayni sharoitda raqobatga bardosh berishi, o‘ziga sarflangan mablag‘larni oqlashi va rentabellikka ega bo‘lishi uchun iloji boricha shaharni kengroq qamrab olishi kerak. Shundagina unda yo‘lovchilar oqimi ko‘payadi va iqtisodiy foydali, tabiiy bezarar transport sifatida faoliyat yuritishda davom etadi. So‘nggi yillar vatanimizda ro‘y berayotgan keng qamrovdagi o‘zgarishlar, islohotlar metro sohasiga ham ko‘plab yangiliklarni olib kirdi. Prezidentimiz Shavkat Mirziyoyev tomonidan ilgari surilgan 2017–2021 yillarda O‘zbekiston Respublikasini rivojlantirishning beshta ustuvor yo‘nalishi bo‘yicha harakatlar strategiyasi loyihasi ushbu islohotlar samarasini oshirish, mamlakat va jamiyat rivojini yangi bosqichga ko‘tarishga qaratilgan.

Prezidentimiz tashabbusi bilan transport sohasi, jumladan, metropolitenni yanada rivojlantirishga alohida e’tibor qaratilmoqda. Xususan, 2016 yilning 18 sentyabr kuni Prezident Shavkat Miromonovich Toshkent shahrining tumanlari bo‘ylab uyushtirgan safarlarida qator obyektlarning qurilish ishlari bilan shaxsan tanishdi. Shu safar davomida Prezident metroning Yunusobod yo‘nalishi bo‘ylab qurilish ishlarini tiklash haqida qator vazirlik va idoralarga ko‘rsatmalar berdi.

Metro qurilishi jonlandi. Ayni kunda Yunusobod yo‘lining «Shahriston» bekatidan keyingi yana ikki bekatini qurish va 2030 yilgacha rivojlanish dasturiga muvofiq metro yo‘llarini uzaytirish ishlari davom ettirilmoqda.

«Toshkent metroloyiha» instituti tomonidan shaharning boshqa loyihalash institutlari ishtirokida «Yunusobod» yo‘lining «Mingo‘rik» bekatidan «Turkiston» bekatigacha bo‘lgan qismi loyihalangan edi. Unda ko‘ra «Yunusobod» yo‘lining umumiy uzunligi 9,85 km ga yetkazilishi ko‘zda tutilgandi. Bu yo‘nalish kuniga 60–70 ming yo‘lovchi tashish quvvatiga ega bo‘ladi.

Loyihada «Yunusobod» yo‘lini qurish va ishga tushirish ishlari ikki bosqichda amalga oshirilishi belgilangan bo‘lib, birinchi bosqich 2001 yili foydalanishga topshirildi va «Mingo‘rik» bekatidan «Shahriston» bekatigacha 7,1 km uzunlikdagi 6 bekatdan iborat birinchi bosqichi ishga tushdi. Bir vaqtning o‘zida ikkinchi bosqichini qurish ishlari boshlangan.

Ikkinchi bosqich doirasida «Shahriston» bekatidan «Turkiston» bekatigacha ikki bekatni qurish ishlari davom etmoqda. Hozirda 24 va 25-son shaxtalar qurildi, tonnellar kavlash ishlari boshlangan (shu kungacha 1390 metr tonnel o‘tkazildi), metro yo‘li o‘tishi rejalashtirilgan hudud muhandislik kommunikatsiyalaridan tozalandi.

2017–2019 yillar davomida Yunusobod yo‘nalishining ikkinchi bosqichini qurish ishlarini nihoyalash va foydalanishga topshirish rejalashtirilgan. Bugungi kunda tayyorgarlik bosqichi nihoyasiga yetib, qurilish ishlari boshlab yuborilgan.

Shuningdek, poytaxtimizning Sergeli tumanida yer usti metrosini qurish ishlari ham boshlab yuborildi. Bu mavzeda yerosti metrosini qurish muhandislik-geologiya nuqtayi nazaridan juda murakkab vazifa. Shu sababli O‘zbekiston poytaxti uchun yangi, jahon tajribasida esa keng qo‘llanib kelinayotgan «yengil metro» loyihasiga qo‘l urildi. Ya’ni po‘lat izlar yer ostidan emas, yer ustidan estakadalar (ko‘priklar) orqali yotqiziladi. Yo‘nalishning uzunligi 7,1 km ni tashkil etib, «Chilonzor» yo‘lining «Olmazor» bekatidan Sirg‘ali mavzesigacha 6 bekat quriladi.

Yangi Sirg‘ali yo‘nalishining qurilishi ushbu yo‘ldosh shaharchaning Toshkent markazi bilan bog’laydi, transport kommunikatsiyasini yaxshilaydi, mavzeni shaharning boshqa tumanlariga yaqinlashtiradi. «Yengil metro» loyihasi 2017–2020 yillarda amalga oshirilishi rejalashtirilgan. 2017 yilning 3 fevral kuni O‘zbekiston Prezidenti Shavkat Mirziyoyev metroning Sirg‘ali yo‘nalishi qurilish ishlarini shaxsan borib ko‘rdi, qator taklif va ko‘rsatmalar berdi. Davlatimiz rahbari bu loyiha O‘zbekiston tarixida yagonaligini alohida ta’kidladi. Aholiga yanada qulaylik yaratish maqsadida bekatlar usti yopiq tarzda qurilishi kerakligini qayd etdi.

O‘zbekistonda ilk bora Toshkent metropolitenini qurish jarayoniga mexanizatsiyalashgan tonnel o‘tkazish kompleksi (MTO‘K) jalb qilinmoqda. Ushbu zamonaviy texnika Germaniyaning Herrenknecht AG kompaniyasi tomonidan ishlab chiqarilgan.

Herrenknecht AG konserni mexanizatsiyalashgan tonnel o‘tkazish uskunalari bo‘yicha jahonda e’tirof etilgan yetakchi korxonalardan hisoblanadi. Bu har qanday geologik sharoitda 0,10 metrdan 19 metrgacha istalgan diametrdagi tonnellarni o‘tkaza oladigan apparaturalari ishlab chiqarishga ixtisoslashgan jahondagi yagona kompaniyadir.

Shu paytgacha metro quruvchilari tasarrufida faqat katta bolg‘a, belkurak va temir relslarda harakatlanadigan arava bor edi xolos. Bugun esa ularga eng zamonaviy texnologiyalar yordamga kelgan. Endi tonnellarni maxsus tonnel o‘tkazish mashinalari, ya’ni mexanizatsiyalashgan majmua o‘yib bermoqda.

4. Xulosa

Tonnellar qurish hamisha muhandislar oldida turgan murakkab vazifa bo‘lgan. Tonnel o‘tkazuvchilarni qattiq toshli tuproqlar, yumshoq loy va sochiluvchan qum, hamma yoqni bir zumda farq qilishga qodir suvli qatlamlar kutib turadi.

Bu majmua nafaqat yerosti yo‘lagini o‘yib beradi, yana uni mustahkamlab, ortidan tayyor tonnel qoldirib ketaveradi. Majmuaning gumbazlari 2,5 tonna keladigan cho‘yan tyubinglardan ishlangan. Tayyor tonnel halqasi olti tyubingdan iborat. Yerosti yo‘li to‘liq tayyor bo‘lgach, quruvchilar relslarni yotqizadilar va muhandislik tarmoqlarini o‘tkazadilar.

Mashinaning ilgari harakatlanishi domkratlar vositasida amalga oshiriladi. Stansiyalar orasidagi odatdagi masofa 2–2,5 km ni tashkil qiladi. Metro poyezdi bu masofani 3

daqiqada bosib o‘tadi, tonnel o‘yish majmuasi bir kecha-kunduzda 12 metr masofani o‘yadi. Bir oyda 250-300 metr tonnel o‘yish quruvchilar uchun yaxshi ko‘rsatkich sanaladi.

Yer osti yo‘liga ingichka navigatsion elektronika o‘tkaziladi. Uning yordamida majmua mashinisti yo‘nalish koordinatalarini aniqlab boradi. Mutaxassislarning ta’kidlashicha, bu jarayonda majmua berilgan parametrlardan ko‘pi bilan 8 millimetrga chetga chiqishi mumkin ekan.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Norkulov Suxrob Turakulovich	“Toshkent Metropoliteni” DUK boshlig‘ining ilmiy-innovatsion rivojlantirish masalalari bo‘yicha o‘rinbosari - Toshkent davlat transport universiteti prorektori E-mail: sni.kor@bk.ru https://orcid.org/0000-0001-8047-0835

Estimating the capacity of traffic links by modeling passenger traffic

T.Sh. Muminov[1][a], D.F. Yuldoshev[1][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: Research on passenger movement in high-traffic areas plays an important role in improving the quality of this service. In the article, the authors developed the scheme and time of transfer from one transport to another transport in the area of concentration of passenger traffic (train station) in terms of gender, age, level of their load and the trajectory of their movement.

Keywords: simulation model, transport communication, coordination, AnyLogic, mathematical model, comfort, bus, railway.

Yo‘lovchilar harakatini modellashtirish orqali transport o‘tish bog‘lamlarining o‘tkazuvchanlik qobiliyatini baholash

Mo‘minov T.Sh.[1][a], Yo‘ldoshev D.F.[1][b]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Jamoat transportlarida hizmat sifatini oshirishning muhim omillardan biri bu yo‘lovchilar oqimi ko‘p yig‘iladigan hududlarda harakatchanlikni tadqiq etishdir. Maqolada mualliflar tomonidan yo‘lovchilar oqimi ko‘p yig‘iladigan hududda (transport-o‘tish bog‘lamalarida) yo‘lovchilarning bir transportdan boshqa transportga qayta o‘ttirishga sarflanadigan vaqtlarning taqsimlanishini ifodalovchi imitatsion modeli ishlab chiqilgan.

Kalit so‘zlar: Imitatsion model, transport-o‘tish bog‘lamasi, muvofiqlashtirish, AnyLogic, matematik model, komfortabellik, avtobus, temir yo‘l.

1. Kirish

Yo‘lovilar oqimining imitatsion modelini ishlab chiqish, transport-o‘tish bog‘lamalarida yo‘lovchilar harakaini loyixalashning asosiy bosqichi xisoblanadi. Transport o‘tish bog‘lamalarida texnologik jarayonlarni samarali tashkil etishning asosiy maqsadi - yo‘lovchilar xavfsizligi va komfortabillikni yuqori darajada ta’minlashdan iboratdir.

Transport o‘tish bog‘lamalari – transport turlarining o‘zaro tutashadigan va ko‘p sonli yo‘lovchilar oqimi yig‘iladigan hudud xisoblanadi. Transport o‘tish bog‘lamalarining samaradorlik ko‘rsatkichlarini oshirish uchun avvalo transport turlarining xarakatini o‘zaro muvofiqlashtirish va tashish jarayonlarini tug‘ri tashkil etish zarur. Matematik model orqali transport o‘tish bog‘lamalarida kechadigan jarayonlarni hamda yo‘lovchilar oqimining o‘zgaruvchanligini bashoratlash masalalari xisoblanadi. Nazariy jixatdan transport o‘tish bog‘lamalari murakkab bo‘lgan ko‘p elementlar va jarayonlarni o‘z ichiga oladigan tizim xisoblanadi. Bunday tizimni magnitli yoki gazokinetik usullar yordamida modellashtirib bo‘lmaydi. Buning uchun boshqacha yondashuv, yo‘lovchilar oqimining o‘zgaruvchanligini fikran tasavvur eta olish zarur.

2. Muammoning o‘rganilganlik darajasi

Transport o‘tish bog‘lamalarida transport turlari bo‘yicha yo‘lovchilar xarakatini muvofiqlashtirish ko‘plab ko‘rsatkichlar bilan bog‘liqligi sababli, masalaga turli tadqiqotchilar turlicha yondashishgan. Masalan Yevropalik olimlar A.A. Yerofeyev, A.Y. Ribichenoklar transport o‘tish bog‘lamalarining faoliyati samaradorligini baholashda matematik modellashtirishdan foydalanish maqsadga muvofiqligini asoslashgan. Tadqiqotda transport o‘tish bog‘lamalarida metamodellardan foydalangan xolda yo‘lovchilar harakatchanligi o‘rganilgan. Raqamli texnologiyalardan foydalangan xolda yo‘lovchilar xarakatining simulyatsion modeli ishlab chiqilgan. Shuningdek tadqiqot natijalarida transport o‘tish bog‘lamalarida yo‘lovchilar xarakatining optimal boshqaruv yechimi keltirilgan. Osiyolik tadqiqotchilar A. Khattaka., A. Hussainc o‘z tadqiqotlarida TCRP dasturi asosida yo‘lovchilar harakatini multimodal tashish tamoyillari bo‘yicha tahlil qilishgan. Tadqiqotda yo‘lovchilar oqimi jadalligi (zichligi) ning kun soatlari bo‘yicha yuqori bo‘lgan

[a] https://orcid.org/0009-0006-3167-3808
[b] https://orcid.org/0000-0002-6042-2737

va yuqori bo‘lmagan sharoitlarida o‘rganilgan holda jarayonlarni optimallashtirish choralari ko‘rilgan.

Transport o‘tish bog‘lamalarida eskolator qurilmalaridan ko‘tarilishda yoki tushishda yo‘lovchilarning harakatlanishi sekinlashishi tufayli oqim zichligi orishi va natijada tirbandliklar kuzatilishini aniqlashgan. Tadqiqot ishi davomida, yo‘lovchilar oqimining o‘rtacha tezligi transport o‘tish bog‘lamalaridagi tirbandlik muammolarini keltirib chiqaruvchi asosiy omil bo‘lishi aniqlangan. [1,6]

P.I. Kozlov Yo‘lovchilar oqimiga ishonchli transort xizmatini ko‘rsatish bo‘yicha tadqiqotlar olib borgan. Shuningdek transport uzellarida, vokzal hududida transport o‘tish bog‘lamalarida yo‘lovchilar harakatini kompleks baholash me’zonini ishlab chiqqan. [2,7]

V.M. Antonova, N.A. Grechishkina, N.A. Kuznetsovlar tomonidan Anylogic dasturidan foydalangan holda metro bekatlari hududlarida yo‘lovchilar oqimining yuklanganlik darajasini baholashning simulyatsion modeli ishlab chiqilgan. [3,8]

A.I.Fadeev, YE.V. Fominlar o‘z tadqiqotlarida shahar jamoat transportlarida yo‘lovchilar oqimiga mos harakatlanuvchi tarkibning (kichik, o‘rta va katta sig‘imli avtobuslar) maqbul tarkibini aniqlash masalasi bo‘yicha o‘rganishlar olib borishgan. [4,9]

A.P. Timalsena. Tirbandliklar hosil bo‘lganda yo‘lovchilarning ortiqcha yo‘qotadigan vaqtlarini transport turlari (velosiped, yengil avtomobil, turli sig‘imli avtobuslar) bo‘yicha tahlil qilgan. Yo‘lovchilarni transportda qatnovga sarflaydigan vaqtini kamaytirish uchun ertalabki va kechki «tig‘iz soatlarda» oqim yuqori bo‘lgan yo‘nalishlarda transport vositalari harakatiga ustunlik berish takliflari ishlab chiqilgan. [6,8].

3. Tadqiqot metodikasi

Mazkur olimlar tomonidan olib borilgan tadqiqotlar tahlili shuni ko‘rsatadiki, bu ishlarning barchasida aholiga ko‘rsatilayotgan transport xizmatlari sifati va uni ta’minlashga alohida e’tibor qaratilmoqda. Biroq aholiga ko‘rsatilayotgan transport xizmatlari sifatiga ta’sir etuvchi ko‘rsatkichlarning keskin o‘zgarishi yetarlicha o‘rganilmagan. Bundan tashqari, olib borilgan tadqiqotlarda yo‘lovchilar oqimi yo‘lovchilarning yoshi bo‘yicha, jinsi bo‘yicha va shu kabi boshqa ko‘rsatkichlari bo‘yicha o‘rganishlar yetarli darajada emas. Transport o‘tish bog‘lamalarida yo‘lovchilarning harakat vaqtlari va ularning tashkil etuvilari yetarlicha ko‘rib chiqilmagan.

Yuqorida belgilangan muammolarni xal etish uchun navbatdagi vazifalarni bajarish lozim.

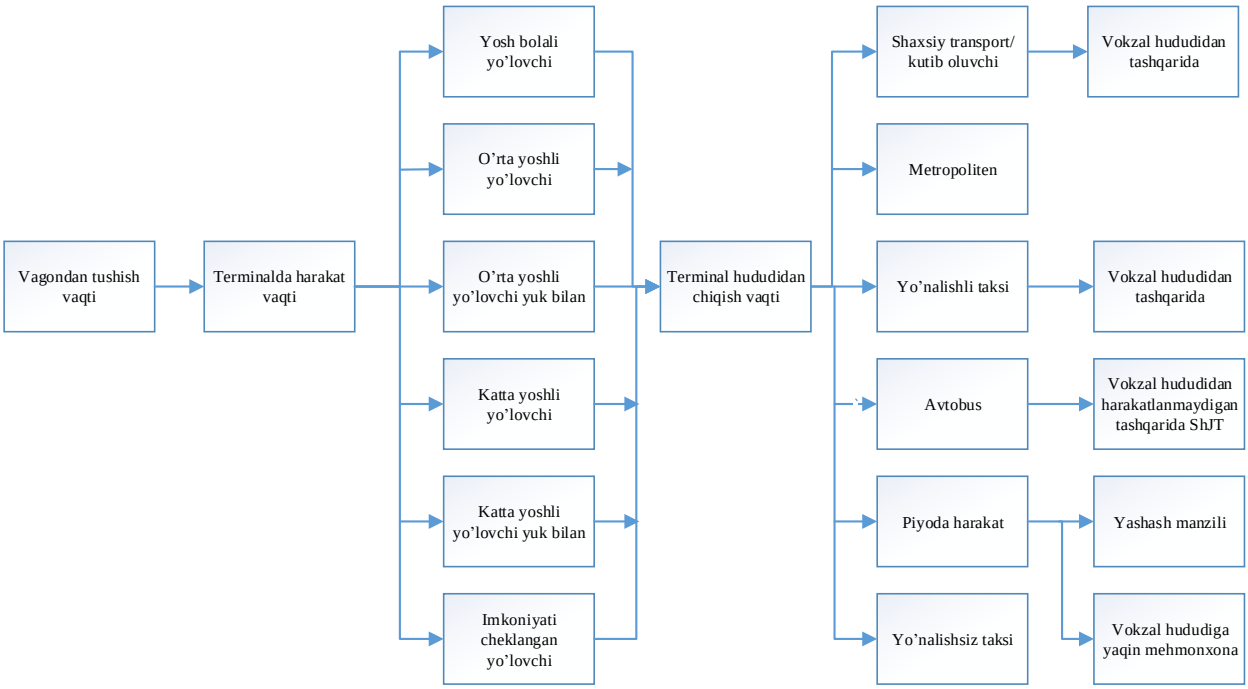
yo‘lovchilarni vagondan tushish vaqtlari, yo‘lovchilarni vokzal hududidan avtobus bekatlarigacha bo‘lgan masofalarda (platformalarda, yo‘laklarda) harakatini o‘rganish;

yo‘lovchilarni jinsidan, yoshidan va ularning imkoniyatlaridan kelib chiqqan holda ularning harakat vaqtlari bo‘yicha sinov tadqiqotlarini o‘tkazish orqali o‘rganish;

yo‘lovchilar oqimiga mos avtobuslar turi, sonini tanlash va asoslash;

yo‘lovchilar oqimini kunlar, oylar, yillar bo‘yicha tahlil etish kabi masalalarga yechim izlash.

Yo‘lovchilarni transport o‘tish bog‘lamalarida xarakati turlicha kechadi. Yo‘lovchilar xarakatining sxematik ko‘rinishi quyidagicha ko‘rinish oladi.



1-rasm. Yo‘lovchilar xarakatining sxematik ko‘rinishi

Yo‘lovchilar xarakatini imitatsion modelini shakllantirishda modellashtirilayotgan tizimning quyidagi o‘ziga xos xususiyatlarini xisobga olish zarur ya’ni:

transport o‘tish bog‘lamalardagi yuklanishning noteks taqsimoti;

shaxar atrofi shaxarlararo temir yo‘l transporti va shaxar jamoat transporti xarakat grafigi (ko‘p sonli yo‘lovchilar oqimini qisqa vaqt oralig‘ida tarqatish);

shaxar atrofi shaxarlararo temir yo‘l transportida kelgan yo‘lovchilarni shaxar jamoat transportiga noteks

taqsimlanishi (yo‘lovchilarni vokzal xududining qaysi tomonidan tark etishi);

xarakatlanuvchi tarkib, vagon, eskolator, turniket va platformalar texnik xususiyatlari;

platformalarda yo‘lovchilar piyoda xarakat tezligi.

Temir yo‘l transportida xarakatlanib kelgan yo‘lovchilar vokzal hududidan tark etishlarida turlicha jarayolarda vaqt sarf etadi. Bunda birinchi navbatda vagonning bo‘shash vaqti quyidagicha aniqlanadi.

$$T_{\text{туш}} = \frac{q_{\text{в}} \cdot \gamma_{\text{в}} \cdot t_{\text{ўрт}}}{n_{\text{тамбур}}} \quad (1)$$

bu yerda:

$q_{\text{в}}$-vagon sig‘imi;

$\gamma_{\text{в}}$-vagon sig‘imidan foydalanish koeffsiyenti;

$t_{\text{ўрт}}$-yo‘lovchining vagondan o‘rtacha tushishga sarflaydigan o‘rtacha vaqti;

$n_{\text{тамбур}}$- vagon to‘xtaganda ochiladigan tambur soni.

Yo‘lovchini vagondan tushishga sarflaydigan o‘rtacha vaqti quyidagicha aniqlanadi.

$$t_{\text{ўрт}} = \frac{\sum n_i t_{\text{ўрт}.i}}{\sum n_i} =$$

$$t_{\text{ўрт}} = \frac{n_{\text{йўлов}} \cdot t_{\text{ўрт,ёш}} + n_{\text{йўлов}} \cdot t^{\text{юк}}_{\text{ўрт,ёш}} + n_{\text{йўлов}} \cdot t_{\text{катта,ёш}} + n_{\text{йўлов}} \cdot t^{\text{юк}}_{\text{катта,ёш}} + n_{\text{йўлов}} \cdot t_{\text{им,чек,йўлов}}}{n_{i\,(\text{йўловчи})}} \quad (2)$$

Yo‘lovchi jinsi, xolati va imkoniyatidan kelib chiqqan xolda vokzal hududidan avtobus bekatigacha piyoda harakat vaqti turlicha bo‘ladi va quyidagicha aniqlanadi.

$$t_{\text{пиёда харакат}} = \frac{l_{\text{ўрт}}}{V_{\text{й,ўрт}}} \quad (3)$$

bu yerda:

$V_{\text{й,ўрт}}$- yo‘lovchining o‘rtacha xarakat tezligi;

$l_{\text{ўрт}}$- yo‘lovchining o‘rtacha qatnov masofasi.

Yo‘lovchining jinsidan kelib chiqqanda, xolatidan kelib chiqqanda, bosib o‘tadigan masofasi xar xil bo‘lganligi sababli yo‘lovchining o‘rtacha xarakat tezligi quyidagi ko‘rinishga ega bo‘ladi.

$$V_{\text{й,ўрт}} = \sum_{i=1}^{i=K} \frac{(l_{mi} q_{ni})}{(n_i t_i)} = \frac{l_{m1} q_{n1} + l_{m2} q_{n2} + l_{m3} q_{n3} + \cdots . l_{mk} q_{nk}}{q_{n_1} t_1 + q_{n2} t_2 + q_{n3} t_3 + \cdots . q_{nk} t_k} \quad (4)$$

бу ерда:

l_m-йўловчилар вокзал худудидаги харакат масофалари;

t- йўловчилар вокзал худудидаги харакат вақтлари;

q_n- йўловчилар сони.

Vokzal hududida temir yo‘l platformasida poyezd vagonlari joylashuvi xar-xil masofada bo‘lganligi sabab piyodalar o‘rtacha bosib o‘tadigan masofa quyidagicha aniqlanadi.

$$l_{\text{ўрт}} = \frac{\sum (l_i \cdot q_i)}{\sum Q_i} = \frac{l_1 \cdot q^{1\text{в}}_{\text{йўлов}} + l_2 \cdot q^{2\text{в}}_{\text{йўлов}} + l_3 \cdot q^{3\text{в}}_{\text{йўлов}} \ldots . l_n \cdot q^{n\text{в}}_{\text{йўлов}}}{Q_{\text{йўлов}}} \quad (5)$$

bu yerda:

$l_1, l_2,$ - temir yo‘l platformasida poyezd vagonlari joylashuvi masofalari;

$q^{1\text{в}}_{\text{йўлов}}$- temir yo‘l platformasida poyezd vagonlari tartibi va undagi yo‘lovchilar soni.

Yuqoridagi ifodalardan kelib chiqqan holda “AnyLogic” dasturi orqali yo‘lovchining simulyatsion xarakat modelini ishlab chiqish mumkin. Quyida (2-rasm.) Toshkent “Janubiy temir yo‘l” vokzalida yo‘lovchilarni platformalarda xarakatlanish modeli ko‘rsatilgan. Modelda yo‘lovchilarning temir yo‘l platformasidagi xarakati yani agar poyezd bir vaqtda 3 ta yo‘lda to‘xtab yo‘lovchilarni tushursa vokzalning chiqish yo‘lagi tomon yo‘lovchilarning xarakati o‘z aksini topgan. Modelda intensiv xarakatni soatiga 1000 yo‘lovchi, o‘rtacha xarakat tezligi etib 4km/soat belgilangan.

2-rasm. Yo‘lovchining “AnyLogic” dasturida ishlab chiqilgan simulyatsion xarakat modeli

Ishlab chiqiladigan imitatsion model samaradorligi yo‘lovchilar oqimining yoshidan, jinsidan va xolatiga nisbatan xisobga olgan xolda ular xarakat vaqtini, yo‘lovchilarni vagonlardan tushish, platformadagi va vokzal xududini tark etishda noteks xarakatini baxolash imkoniyatini yaratadi. Yildan yilga axoli sonining o‘sib borishi, transportga bo‘lgan talabni oshishiga olib keladi shunday ekan taklif etilayotgan model orqali vokzal xududining o‘tkazuvchanlik qobiliyatini baxolashga xam erishiladi.

4. Xulosa

Transport-o‘tish bog‘lamalarida yo‘lovchilar harakatini tadqiq etilib hududda yuzaga keluvchi muammolar o‘rganildi. Muammolar asosan hududda yo‘lovchilar oqimining ma’lum vaqt oralig‘ida to‘planishi va ularni o‘zlarinning harakat trayektoriyasi bo‘yicha tarqalish vaqtining ortishi bilan asoslanadi. Yuqoridagi ifodalarda xar bitta ko‘rsatkich va ularga ta’sir etuvchi omillar ko‘rib chiqildi. Ma’lum bo‘ldiki ular bir-biriga bog‘liq demak bu kompleks yechim talab etadi. “AnyLogic” dasturiy ta’minoti va matematik usullardan foydalangan holda yo‘lovchilarning harakat trayektoriyasi va ularning vokzal hududida harakat vaqtlari ifodalari ishlab chiqildi. Keyingi ilmiy ishlanmalarda temir yo‘l va shahar yo‘nalishli avtobuslar harakatini muvofiqlashtirish va harakat grafigini ishlab chiqish masalalari ko‘rib chiqiladi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Mo‘minov To‘lqin Shoyqulovich	Toshkent davlat transport universiteti “Transport logistikasi” kafedrasi assistenti, E-mail: tulqinmuminov643@gmail.com Tel.: (+99890) 1686835 https://orcid.org/0009-0006-3167-3808
Yo‘ldoshev Davron Furqat o‘g‘li	Toshkent davlat transport universiteti “Transport logistikasi” kafedrasi t.f.f.d. (Phd) E-mail: davron.yoldoshev@bk.ru Tel.: (+99897) 4114169 https://orcid.org/0000-0002-6042-2737

Analysis of solar cells can be used in the design of solar-powered UAV

J. Sh. Narimanov[1][a]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: Interest in solar-powered unmanned aerial vehicles (UAV) is increasing today due to their ability to fly for long periods of time. Solar cells play an important role in their long-term flight, and the right choice of solar cell technology has a significant impact on the performance and efficiency of these solar-powered UAVs. This article analyses various solar cells for solar powered UAVs, considering their specifications such as efficiency, power output, weight, etc., and other factors such as installation, durability, and cost effectiveness. Various types of solar cells, including silicon-based, thin-film, multi-junction, and emerging technologies, are evaluated based on their suitability for solar-powered UAV applications and at the end, conclusions are presented on the selection of the most optimal solar cell that can be used in the design of such UAVs.

Keywords: Solar-powered, solar cell, photovoltaic, long-endurance

1. Introduction

When it comes to the design and development of solar-powered UAVs (Unmanned Aerial Vehicles), selecting the right type of solar cells is critical for maximizing efficiency, power output, and integration with the UAV's design. Solar energy is considered sustainable energy and the main goal of using it in flight is to achieve longer flight endurance, and the main means to achieve this is the use of solar cells in drone construction and design in general. Of course, each solar panel UAV is different depending on the field of application and the mission it performs, which means that in this case their flight duration requirements will be different as well as the actual flight durations. Furthermore, the use of solar cells alone may not be sufficient to achieve the intended flight duration. There are other factors to consider, such as drone size, weight, construction, especially the integration of solar cells with the wing, drone mission, weather (available sunlight, etc.), solar cells and their type, etc.

The following is an analysis of the solar cells that can be used in the design of a solar panel drone through the method of reviewing the available literature and sources, presenting the specifications, data of the various solar cells, the solar cells used in the drones reported so far and the results they have shown, as well as the above taking into account the listed factors, solar cells are divided into groups.

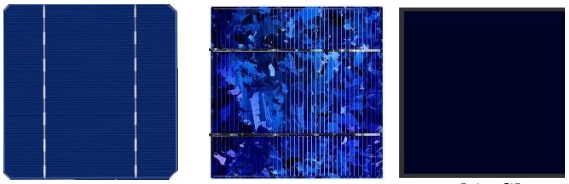
1.1. Silicon-based solar cells.

Silicon is a common and inexpensive material [1], and approximately 85% of photovoltaic cells on the market are solar cells made of this material [2]. Also, most of the solar-powered UAVs developed so far, for example, Switzerland's AtlantikSolar 2, China's Mini-Phantom UAV, used monocrystalline solar cells made of this material. Solar cells made of this material can be divided into 3 types (figure 1):

- monocrystalline silicon (mono-Si), (or single-crystalline);
- polycrystalline or polysilicon (p-Si) and multi-crystalline silicon (mc-Si);
- amorphous (a-Si), (or thin-film cell).

Monocrystalline solar cells.

Consisting of a single continuous crystal structure, they are highly efficient and have a high power-to-weight ratio. They typically offer a high efficiency rating of 15-20% [3], with even later brands slightly exceeding 22%, and can perform well in low sunlight conditions and have a longer lifespan. Often these solar cells can be more expensive (compared to polycrystalline for example) and less flexible, which can be considered a disadvantage when designing solar-powered UAVs that require a panel composed of flexible or lightweight solar cells.



Monocrystalline **Polycrystalline** **Thin film**

Figure 1. Silicon-based and thin film solar cells

Another important factor is the ease of finding and buying these cells. For example, it can be seen their existence and wide spread even when looking at various Internet online trading markets. Monocrystalline solar cells include brands such as Sunpower C60, Sunpower A300, Sunpower Maxeon Gen 6, etc., that can be used in the design of solar UAVs. However, for example, solar cells of this type were used in solar UAV projects such as MARAAL, AtlantikSolar, SoLong, Sunsailor 1, Sunsailor 2 [5] and Solar Impulse 2 aircraft. Table 1 provides specification information for some monocrystalline solar cells, and Fig. 2 shows a typical I-V (current-voltage) curve diagram of the Sunpower C60.

Polycrystalline solar cells.

Polycrystalline solar cells, also known as multicrystalline silicon cells, are a popular type of photovoltaic technology used to convert sunlight into electricity. Unlike their monocrystalline counterparts, which are made from single crystals of silicon, polycrystalline cells are composed of multiple silicon crystals.

The production of polycrystalline solar cells begins with silicon that is melted and then poured into molds to form

[a] https://orcid.org/0009-0002-1427-5972

blocks known as ingots. These ingots are then sliced into thin wafers, which are the basis for solar cells. The process is less complex than the creation of monocrystalline cells, which involves pulling a single crystal from molten silicon.

Polycrystalline solar cells are characterized by their distinct blueish hue and the visible grainy texture on their surface. This texture results from the multiple silicon crystals within the cell. One of the primary advantages of polycrystalline cells is their lower production cost compared to monocrystalline cells. This is largely due to the simpler manufacturing process and reduced silicon waste.

Table 1

General and electrical specifications of two monocrystalline solar cells

Sunpower C60				
Dimensions (Length x width)		***Thickness***	***Weight***	***Efficiency***
125 mm x 125 mm (nominal)		(165µm ± 40µm)	-	~ 22.5 %
Rated power Pmpp (Wp)	***Voltage at maximum power point Vmpp (V)***	***Current of module at maximum power point Impp (A)***	***Open-Circuit Voltage Voc (V)***	***Short-Circuit Current Isc (A)***
3.42	0.582	5.93	0.687	6.28
Sunpower A300				
Dimensions (Length x width)		***Thickness***	***Weight***	***Efficiency***
125 mm x 125 mm (nominal)		270 µm ± 40 µm	-	~ 21.5 %
Rated power Pmpp (Wp)	***Voltage at maximum power point Vmpp (V)***	***Current of module at maximum power point Impp (A)***	***Open-Circuit Voltage Voc (V)***	***Short-Circuit Current Isc (A)***
3.1	0.560	5.54	0.670	5.9

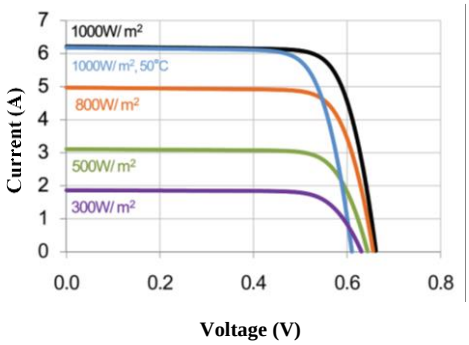


Figure 2. Sunpower C60 Typical I-V Curve

In terms of efficiency, polycrystalline solar cells typically have a lower conversion efficiency than monocrystalline cells. This means that polycrystalline cells generally produce less power per square meter of panel compared to their monocrystalline counterparts. However, advancements in technology and manufacturing processes are continually improving their performance. The efficiency rating of polycrystalline panels typically ranges from 13% to 16%. Even though it is only a little percentage point less than monocrystalline panels, when multiplied over numerous solar panels, the difference can add up [9].

Amorphous Silicon cells.

Actually, this kind of photovoltaic cell can be included in the thin film group. This kind of thin-film photovoltaic cell utilizes non-crystalline silicon. Contrasted to crystalline silicon utilized in typical silicon solar cells, amorphous silicon is applied in thin layers on a substrate. Although it is more flexible and inexpensive to produce than crystalline silicon cells, its efficiency is usually lower. Its low photoelectric conversion efficiency is its biggest flaw. Currently, the efficiency ranges from 4-8% in commercial modules to about 13.5% in laboratories alone [10]. In addition to the characteristics of this solar cell, it is lightweight.

1.2. Thin-Film Solar Cells.

Thin-film photovoltaic cells (figure 1) represent a category of photovoltaic technology designed to convert sunlight into electricity with a streamlined and flexible approach. Unlike traditional silicon-based solar cells, which use a solid, crystalline structure, thin-film cells are composed of layers of photovoltaic material that are only a few micrometres thick. This design enables the production of lightweight and flexible panels.

The core advantage of thin-film technology lies in its versatility and manufacturing efficiency. These cells can be deposited on a variety of substrates, including glass, plastic, or metal, letting them to be combined into various applications.

Thin-film photovoltaic cells make use of various materials to catch sunlight, such as cadmium telluride (CdTe), amorphous silicon (a-Si), or copper indium gallium selenide (CIGS). Each material has unique properties that influence the cell's efficiency, durability, and production cost. For instance, CdTe cells are known for their low production cost and relatively high efficiency in converting sunlight into electricity, while CIGS cells offer high efficiency and flexibility but are more complex to manufacture.

The primary challenge with thin-film solar cells is their efficiency compared to traditional silicon-based cells. While thin-film cells generally offer lower efficiency, advancements in technology and manufacturing processes are continuously improving their performance and making them more competitive in the renewable energy market.

Cadmium telluride solar cells

Cadmium telluride solar cells are photovoltaic devices that use a thin layer of cadmium telluride (CdTe) to generate electricity from light. In contrast to crystalline silicon photovoltaic technology, CdTe solar cells use a thin film of semiconductor, a smaller amount, to convert absorbed light energy into electrons. Despite having lower efficiency than crystalline silicon devices, CdTe solar cells can be produced at a lower cost, and the technology has the potential to outperform silicon in terms of cost per installed kilowatt. Even though thin film technologies only make up a small portion of the solar device market, this industry is predicted to expand quickly due to the strong interest in creating novel methods of manufacture that may allow for economies of scale.

Amorphous silicon, which was randomly deposited onto a substrate (as opposed to the regular crystal lattice found in wafer crystals) was the first thin film technology to be invented. There were a few issues with this technology: the cells were inefficient, and the process of depositing silicon onto the substrate was expensive and time-consuming. Because of its excellent solar spectrum matching and 1.4

electron volt band gap - the energy required to drive an electron from its atom into a condition where it may flow freely - CdTe thin film technology is approximately 11% more efficient than amorphous silicon.

Because the CdTe thin film is a high-throughput technique and can be deposited onto the substrate rapidly, it is also far more suitable for mass manufacturing. A p-doped layer of cadmium telluride, referred to as the "absorber", sits atop an n-doped cadmium sulphide junction, or "window layer," in each cell. Cadmium sulphide is covered by a transparent conductive front contact, and the CdTe is in contact with a conductive rear surface substrate. Fig. 3 show different layers of CdTe/CdS thin film photovoltaic sells.

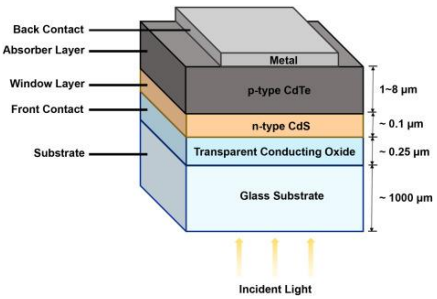


Figure 3. Structural layers of CdTe/CdS solar cells

Since cadmium is a cumulative poison, the electronics industry has taken steps to try and remove elemental cadmium from personal devices despite its potential. Cadmium has been effectively removed from electronic equipment in Europe thanks to the Restriction of Hazardous Substances (RoHS) regulations, which were implemented in response to health concerns. Cadmium not only poses a health concern to consumers, but it also poses a risk to miners during the raw material extraction process, workers involved in the processing of the material, and disposal workers during the end of their lives.

Proponents claim that cadmium in the form of a thin film solar cell is more stable and less soluble than in other electronics and that there would be little risk to health and the environment, as the alloys are encapsulated within the modules. However, there have been concerns regarding cadmium leaching from broken modules. Additionally, although it has been promoted that closed-loop recycling would address any concerns over end-of-life disposal, critics highlight that even closed-loop recycling systems do not recover everything [11, 18].

Copper indium gallium selenide solar cells

Copper indium gallium selenide (CIGS) solar cells are a prominent type of thin-film photovoltaic technology known for their efficiency and versatility in converting sunlight into electrical energy. These cells are composed of a compound semiconductor material, which is primarily made up of copper (Cu), indium (In), gallium (Ga), and selenium (Se). The unique properties of these materials enable CIGS solar cells to offer several advantages over traditional silicon-based solar cells.

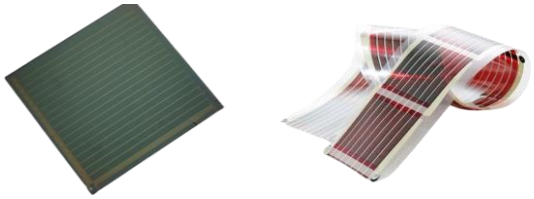
The deposition of the CIGS layer is usually achieved through techniques such as sputtering, co-evaporation, or chemical vapor deposition (CVD). These methods allow for precise control over the composition and thickness of the CIGS layer, which is crucial for optimizing the cell's performance.

CIGS solar cells are renowned for their high efficiency in converting sunlight into electricity. They typically achieve efficiencies of around 15-20% in commercial applications, though laboratory prototypes have reached efficiencies exceeding 23%. This level of performance is competitive with, and in some cases surpasses, that of traditional silicon-based solar cells [11].

One of the key factors contributing to the high efficiency of CIGS cells is their direct bandgap, which is ideal for absorbing a broad spectrum of sunlight. This characteristic allows CIGS cells to capture more energy from sunlight compared to materials with an indirect bandgap, such as silicon.

1.3. Emerging and Specialized Solar Cells

Recent advancements in solar cell research have introduced promising alternatives for UAVs. Perovskite solar cells have garnered attention for their potential to achieve high efficiencies comparable to silicon-based cells while offering lower manufacturing costs and the ability to be fabricated on flexible substrates. Organic photovoltaics (OPVs) present another avenue with their lightweight and flexible nature, although current efficiencies are lower than those of silicon-based and perovskite cells. Continued research and development efforts aim to improve the efficiency, stability, and scalability of these emerging technologies for UAV applications. Figure 5 shows perovskite and organic photovoltaic solar cells.



a) Perovskite solar cell b) Organic photovoltaic cells

Figure 5. General view of Perovskite and Organic solar cells

Perovskite solar cells

The core of a perovskite solar cell is the absorption layer, which is made up of a material with a crystal structure that absorbs light and partially converts it into a stream of electrical charges that we refer to as electrons (positively charged) and holes (negatively charged). The perovskite layer is surrounded at both the top and bottom by layers of transport material that only permit one of the two types of charges to pass through: holes or electrons. This charge transport creates a voltage difference, with the layer that accepts holes becoming positive and the layer that accepts electrons becoming negative. The transport layers are covered with conductive electrodes to allow the electric current to flow correctly.

Perovskite solar cells can be applied as extremely thin layers to a variety of substrates, such as glass, foil, or another solar cell, because at least one of these electrodes - the front of the photovoltaic cell - is transparent and the stack of layers is only a thousandth of a millimetre thick [15].

Organic photovoltaic cells

The newest development in solar cell technology, organic solar cells, also referred to as organic photovoltaic cells (OPV), are attracting the interest of business experts. This is mostly because of their excellent performance, their

unparalleled capacity to absorb solar energy, and the remarkable adaptability of the technology.

In contrast to conventional crystalline solar cells, which employ silicon as an absorber, organic solar cells use an organic electronics and polymer or small molecule cell composed of carbon-based materials. This makes it possible to create a thinly-film solar cell that is incredibly flexible, light, and thin. In comparison with usual photovoltaic cells, organic photovoltaic cells have a far wider coverage area and are far more robust due to their unique device structure.

The procedure for producing monocrystalline and polycrystalline silicon solar cells is the same for organic solar cells. The process via which all of these kinds of photovoltaic cells generate electricity is called the photovoltaic effect. The direct atomic-level conversion of light into electricity is known as the photovoltaic effect. The solar cell absorbs light in the form of tiny energy bundles called photons as the initial step in this process. After the photons are knocked by the solar cell, the electrons escape the semiconducting material and are picked up by electron acceptors. When the electrons are free to move around the solar cell, they can pass through charge carriers and produce an electrical current. After that, that electric current is collected and distributed throughout any house.

The photovoltaic mechanism works similarly for silicon and organic solar cells. The semiconducting substance used in each solar cell is the only variation. Organic solar cells use a carbon-based substance as a semiconductor, as opposed to conventional solar cells, which use silicon [16].

1.4. Multi-junction solar cells

In comparison with single-junction photovoltaic cells, multi-junction photovoltaic cells are more effective in converting sunlight into electricity because they can absorb different wavelengths of incoming sunlight by using different layers. Multi-junction photovoltaic cells have the potential to be many times more efficient than usual photovoltaic cells, but they are not currently viable or commercially available due to high production costs and ongoing research and development. Tandem solar cells, of which multi-junction solar cells are a kind, are constructed from stacked materials that have been specially designed to absorb various sun frequencies.

Semiconductor material, primarily silicon in crystalline solar cells, is used to make solar cells. A solar cell's two layers are typically an n-type, which has a high electron concentration, and a p-type, which has a comparatively low electron concentration. Electrons move from the n-type layer to the second portion when sunlight strikes it, creating an electrical current that may be recorded and used to generate power. Because it includes a single boundary, or p-n junction, between the n-type and p-type layers, this type of photovoltaic cell is referred to as a single-junction photovoltaic cell. In solar cells, electrical currents travel across these p-n junctions.

It is not possible to develop multi-junction photovoltaic cells using silicon as a semiconductor. Rather, distinct layers of semiconductors that react to various wavelengths of incoming sunlight are created using materials such as germanium (Ge), gallium indium phosphide (GaInP), and indium gallium arsenide (InGaAs) [17]. Below are the specifications (table 2) of Spectrolab's NeXt Triple Junction (XTJ) solar cell (figure 6), an example of multi-junction photovoltaic cell.

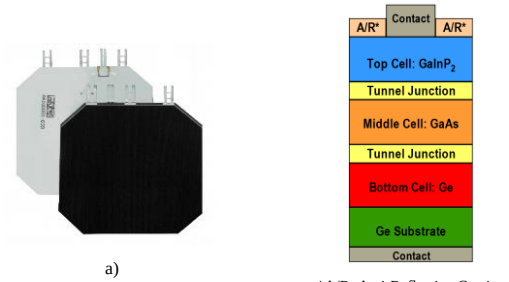
2. Analyses and results

Considering the above, the following analysis and results can be summarized:

1) Silicon-Based Solar Cells:

Advantages:

- High Efficiency: Monocrystalline silicon cells offer efficiencies up to 20-25%, making them suitable for applications requiring high power output in limited space.
- Mature Technology: Extensive research and development have optimized their performance and reduced costs.
- Durability: Silicon cells have a proven track record of long-term reliability and durability.
- Limitations:
- Weight and Rigidity: Silicon cells are relatively heavy and rigid, which may affect the aerodynamics and payload capacity of drones.
- Efficiency Degradation: Performance can degrade over time, particularly in high-temperature environments.



a) b)

*A/R: Anti-Reflective Coating

Figure 6. View (a) and structure (b) of NeXt Triple Junction (XTJ) solar cell

Table 2

Specifications of NeXt Triple Junction (XTJ) solar cell

NeXt Triple Junction (XTJ)				
Dimensions		***Thickness***	***Weight***	***Efficiency***
26.62 cm^2 and 59.65 cm^2		140 µm Ge wafer thickness	84 mg/ cm^2	29.5%
AM0 (135.3 mW/cm^2) 28°C, Bare Cell	***Voltage at maximum power point Vmpp***	***Current of module at maximum power point Impp***	***Open-Circuit Voltage Voc***	***Short-Circuit Current Isc***
	2.348 V	17.02 mA/cm^2	2.633 V	17.76 mA/cm^2

2) Thin-Film Solar Cells:

Advantages:

- Lightweight and Flexible: Thin-film cells are lighter and more flexible compared to silicon-based cells, making them ideal for integration into the curved surfaces of drone wings.
- Low Production Costs: The manufacturing process of thin-film cells is less expensive, contributing to lower costs per watt of power generated.
- Performance in Low Light: Some thin-film technologies perform better in low-light conditions and diffuse sunlight.

Limitations:

- Lower Efficiency: Thin-film cells typically have lower efficiencies, ranging from 10-15%, which may

necessitate larger surface areas for the same power output.
- Shorter Lifespan: These cells may experience faster degradation over time, potentially reducing their effectiveness and reliability in long-term drone operations.

3) Emerging and Specialized Solar Cells:

Advantages:
- High Efficiency Potential: Perovskite cells have demonstrated efficiencies exceeding 25% in laboratory settings, with the potential for further improvements.
- Flexibility and Lightweight: Organic and perovskite cells are highly flexible and can be integrated into various substrates, including lightweight and curved surfaces.
- Cost-Effective Manufacturing: The use of solution-based processing techniques can potentially reduce production costs.

Limitations:
- Stability and Durability: Many emerging technologies, particularly perovskites, face challenges related to long-term stability and environmental degradation.
- Commercial Availability: These technologies are still in the experimental phase or limited commercial production, which may impact their availability and cost-effectiveness.

4) Multi-Junction Solar Cells:

Advantages:
- Exceptional Efficiency: Multi-junction cells can achieve efficiencies greater than 40% under concentrated sunlight, due to their ability to capture a broader range of the solar spectrum.
- Performance in High Light Conditions: They are highly efficient under concentrated solar conditions, making them suitable for high-performance applications.

Limitations:
- Cost: The complexity of manufacturing and the use of rare materials result in high production costs, which may be prohibitive for commercial drone applications.

Weight and Integration: The structure of multi-junction cells can be complex and may add weight, potentially impacting drone performance.

3. Conclusion

In the design of solar panel drones, the choice of solar cells is pivotal. Silicon-based cells offer high efficiency and durability but are limited by weight. Thin-film cells provide flexibility and lower costs but suffer from lower efficiency and shorter lifespan. Emerging and specialized cells promise significant advancements in efficiency and flexibility but face challenges in stability and commercialization. Multi-junction cells deliver unmatched efficiency but at a high cost and weight. Each type of solar cell has its trade-offs, and the optimal choice will depend on the specific requirements of the drone's mission, including payload capacity, flight duration, and environmental conditions.

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Information about the authors

Narimanov Javokhir Shavkat ugli — PhD student at "Aviation Engineering" department, Tashkent State Transport University, E-mail: javokhir.nv@gmail.com https://orcid.org/0009-0002-1427-5972

The importance of calibration in modeling vehicle car-following behavior

D. Urunov[1][a] , S. Ruzimov[2][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan
[2]Kimyo International University in Tashkent, Tashkent, Uzbekistan

Abstract: Nowadays, one of the important issues is the safe traffic on the roads and their arrival at their destination without delay and spending less time and energy. For this purpose, by simulating traffic movements in computer programs, the necessary changes are made without spending a lot of time and money, getting the results. In this article, we considered the importance of calibrating input data in the simulation of traffic movements. In this process, several literatures on calibration were analyzed, experimental work was conducted, conclusions were drawn based on the results, and tasks to be carried out at the next stage were determined.
Keywords: modeling, Weidemann 74 model, calibration, safety distance, lead car

Transport oqimini modellashtirishda kalibrovkalashning ahamiyati

O‘runov D.[1][a], Ruzimov S.[2][b]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston
[2] Toshkent Kimyo xalqaro universiteti, Toshkent, O‘zbekiston

Annotatsiya: Hozirgi kunda yo‘llarda transport vositalarining xavfsiz harakatlanishi va manziliga kechikmasdan kam vaqt va energiya sarflab yetib borishi muhim masalalardan biri hisoblanadi. Buning uchun transport harakatlarini kompyuter dasturlarida simulyatsiya qilish orqali natijalarni olib, ko‘p vaqt va mablag‘ sarflamasdan kerakli o‘zgartirishlar amalga oshirilmoqda. Ushbu maqolada transport harakatlarini simulyatsiya qilishda kiritiladigan ma’lumotlarni kalibrovka qilishning ahamiyatini ko‘rib chiqdik. Bu jarayonda, kalibrlash bo‘yicha bir nechta adabiyotlar tahlil qilindi, sinov tajriba ishlari amalga oshirildi, natijalar bo‘yicha xulosa qilindi va keyingi bosqichda amalga oshiriladigan topshiriqlar belgilab olindi.
Kalit so‘zlar: modellashtirish, Vidman 74 modeli, kalibrlash, xavfsizlik masofasi, yetakchi avtomobil

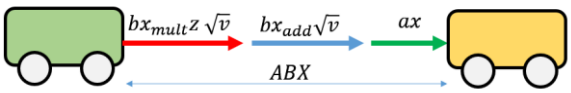
1. Kirish

Transport oqimini boshqarishda alohida transport vositalarining harakatini va ularning o’zaro ta’sirlashuvini o’rganish muhim. Bunda transport oqimini modellashtirish orqali yo‘llarda transport harakatini malakali tashkil etishga erishiladi [1].

So‘nggi yillarda mikroskopik transport oqimi hisob (simulyator) dasturlari yo‘l harakatini tashkil etish muhandislari uchun muhim vositalarga aylandi [2]. Yetakchi (leading) va uni kuzatuvchi (follower) avtomobil orasidagi masofani aniqlash bu dasturlarda asosiy o’rin tutadi [3]. Bu oraliq masofa asosan keng qo’llaniladigan Vidman 74 (Wiedemann 74) modeli orqali ifodalanadi. Bu model parametrlari qiymatlarini tijoriy dasturlarda o’zgarish oraliqlari berib o’tiladi. Lekin haydovchilarning transport vositasini haydash xatti-harakatlari (driver behaviour) turli davlatlarda turlicha bo’lsihi mumkin. Bu o’z navbatida haydovchi parametrlarni kalibrovkalash ahamiyati yuqori ekanligini ko’rsatadi.

2. Metodlar

Yetakchi avtomobil bu oldinda harakatlanuvchi transport vositasi bo‘lib u bilan muayyan oraliq masofani saqlab, yetakchini dinamik ko‘rastkichlarini takrorlashga harakat qiluvchi avtomobilni - kuzatuvchi (yetaklanuvchi) avtomobil sifatida tavsiflash mumkin [4]. Yetakchi va kuzatuvchi avtomobillarni o‘zaro ta’sirlashuvini turli matematik modellari ishlab chiqilgan [4-10]. Bu dasturlarda eng ko‘p tarqalgan model Vidman 74 (Wiedemann 74) modeli Rainer Wiedemann tomonidan 1974 yilda taklif etilgan bo‘lib [10], VISSIM dasturida turli transport oqimida haydovchilarning xatti-harakatlarini taqlid qilish uchun mo‘ljallangan. Bu taqlid asnosida asosan yetakchi va kuzatuvchi avtomobillar oraliq masofasi modellashtirilib, real ma’lumotlarga mos kelishi model aniqligini belgilab beradi.



1-rasm. Vidman 74 modeli [10]

Adabiyotlarda Vidman 74 modeli quyidagi tarzda berilgan chiziqli tenglama shaklda ifodalanadi [10, 11]:

[a] https://orcid.org/0009-0001-6098-5775
[b] https://orcid.org/0009-0003-0120-6166

$$ABX = ax + bx_{add}\sqrt{v} + bx_{mult}z\sqrt{v}$$

Bu yerda:

ABX – oraliq masofa (m);

ax – tinch turgan holdagi oraliq masofa (m);

bx_{add} – qo‘shimcha xavsizlik masofasi, (m);

$bx_{mult}z$ – tezlikka bog‘liqlik masofasi, (m);

v - sekin harakatlanuvchi transport vositasining tezligi, (m/s).

Vidman 74 modelida ax, bx_{add} va $bx_{mult}z$ parametrlarini kalibrovkalash (rostlash) kerak.

Kalibrovkalash simulyatsiya qilingan va eksperimental olingan natijalar qiymatlari o‘rtasidagi farqni minimallashtiradigan model parametrlari to'plamini topishni o‘z ichiga oladi [12].

Yuqorida keltirib o‘tilgan parametrlarning oraliq masofaga ta’sirini o‘rganish maqsadida, Qarshi shahridagi Islom Karimov va Mustaqillik shox ko‘chalari kesishmasidagi aylanasimon harakat tashkil qilingan chorrahaning PTV Vissim dasturida virtual modeli ishlab chiqildi. Natijalarni kalibrovkalashda ax, masofani o‘zgarmas deb qabul qilib va bx_{add} va $bx_{mult}z$ qiymatlarini 0.5 dan 5 gacha 0.5 interval bilan o’zgartirildi. Keltirilgan chorrahaning PTV Vissim dasturida hisob natijalari tahllili quyida keltirilgan.

Ushbu chorrahada ikkita kamera o‘rnatilib 24 soat davomida videoyozuvlar yozib borildi. Ertalab 8.00 dan 9.00 gacha vaqt oralig’ida chorrahadan o‘tgan transport vositalari soni hisoblandi va PTV Vissim dasturida simulyatsiya qilish uchun foydalanildi. Temiryo‘l vokzali tomondan Islom Karimov ko‘chasidan bir soatda 1228 ta transport vositasi, Yerqo‘rg‘on bozori tomondan Islom Karimov ko‘chasidan bir soatda 1897 ta transport vositasi, Qarshi muhandislik iqtisodiyot instituti tomonidan Mustaqillik shox ko‘chasidan bir soatda 1828 ta transport vositasi, Beshkent yo‘li tomonidan Mustaqillik shox ko‘chasidan bir soatda 2175 ta transport vositasi harakatlangan (2-a rasm). PTV Vissim dasturida Qashqadaryo viloyati Qarshi shahri Islom Karimov va Mustaqillik shoh ko‘chalari kesishmasidagi aylanma harakatlanish uchun mo‘ljallangan chorrahasi simulyatsiya qilindi (2-b rasm) .

a)

b)

2-rasm. Qarshi shahri Islom Karimov va Mustaqillik shoh ko‘chalari kesishmasidagi aylanma harakatlanish uchun mo‘ljallangan chorrahasi: a) xaritada ko‘rinishi va b) VISSIM dasturi modeli

3. Natija va muhokamalar

Olib borilgan tadqiqotlar natijasida mamlakatimizda yo‘lovchi transporti xizmati sifatini belgilovchi 6 ta asosiy va 4 ta zarur hollarda hisobga olinishi mumkin bo‘lgan quyidagi parametrlar guruhidan (va parametrlar) iborat bo‘lishi lozimligi aniqlandi.

Chorrahaning parametrlari o‘rganilib PTV Vissim dasturida simulyatsion model tayyorlanildi va bu dastur yordamida olingan natijalar 1-va 2- jadvallarda keltirilgan. 3-rasmda esa ushbu qiymatlarning grafik ko‘rinishi ifodalangan. Bu olingan natijalar tahlilidan keyingi sinov-tajriba ishlarida foydalanish uchun ma’lumot sifatida qo‘llanilishi mumkin. Shuningdek, ushbu maqoladagi uslublardan foydalanib boshqa chorraha va yo‘l segmentlarini kalibrovkalash va simulyatsiya qilish uchun ham foydalanish mumkin.

1-jadval

Chorrahada sarflangan yonilg‘ining bx_{add} va bx_{mult} ko‘rsatkichlari ga mos qiymatlari

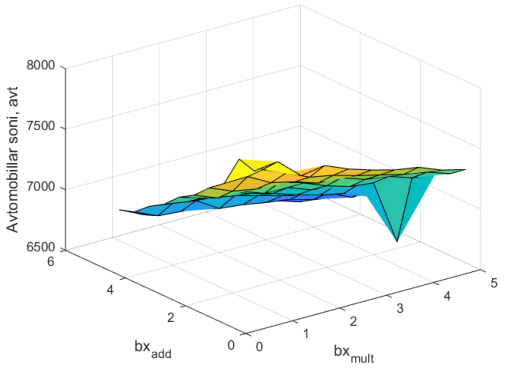
bx_{add}/ bx_{mult}	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
0.5	494.5	492.3	514.8	473.2	474.8	470.6	467.8	466.7	478.3	497
1	484.4	480.8	462.5	476.4	507.4	499.8	499.6	476.4	478.5	488.8
1.5	467.2	457.9	472.7	470.9	487.7	498.2	506.2	493.7	490.1	494.1
2	487.8	507.9	469.9	482.1	491.2	513.4	516.6	504.2	**513.8**	492.4
2.5	478.1	520.4	400.5	515.2	516.6	505.4	502.6	491.7	520.2	495.1
3	508.8	507	490.7	496.2	507.2	499.6	560.9	514.9	512.8	538.6
3.5	515.1	529	502.4	512.4	530	505	485.1	504.1	527.7	525.2
4	518.4	512	506.3	548.8	561.5	526.6	524.8	522.1	597.4	518
4.5	593.5	548.7	562.5	493.7	609.3	535.9	537.1	552.3	544.4	592.8
5	517	530	532.3	515.8	501.7	569.6	546.4	549	563.5	549.1

2-jadval

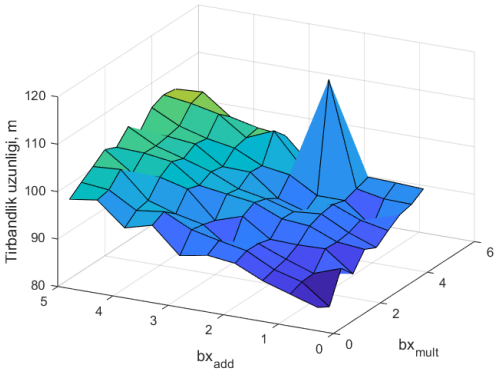
Chorraha tirbandligining uzunligini bx_{add} va bx_{mult} ko‘rsatkichlari ga mos qiymatlari

bx_{add}/ bx_{mult}	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
0.5	82.89	81.4	87.89	85.11	88.67	87.43	89.4	91.13	91.71	93.33
1	84.7	85.68	85.84	89.42	89.25	89.59	90.61	87.62	91.87	93.65
1.5	86.56	87.27	87.87	89.26	91.63	92.55	92.94	92.15	93.02	93.86
2	89.21	90.24	90.15	89.44	92.14	92.04	90.45	92.2	115.06	93.53
2.5	89.93	91.4	88.07	93.3	94.58	93.75	92.26	95.6	95.77	93.95
3	88.82	92.71	92.17	91.44	95.38	94.88	96.78	96.5	102.26	99.61
3.5	94.27	95.52	93.46	97.08	96.23	97.46	96.96	99.24	99.82	100.27
4	92.72	94.78	95.31	98.58	100.24	99.28	100.73	100.28	103.82	101.62
4.5	97.61	98.14	100.84	98.42	101.06	100.95	101.36	101.92	105.07	105.88
5	96.78	98.74	100.46	102.41	101.31	104.03	101.5	104.82	105.89	105.5

a)



b)



3-rasm. Turli bx_{add} va bx_{mult} qiymarlarida a) chorrahadan o‘tayotgan avtomobillar soni va b) ular hosil qilgan tirbandlik uzunligi

Natijalar shuni ko‘rsatdiki, bx_{add} va bx_{mult} qiymatlarining oshishi oraliq masofaning oshishiga olib keladi. Bu o‘z navbatida transport oqimi miqdorlariga ta’sir qilib, chorrahadan o’tgan avtomonillar sonining kamayishi, hosil bo‘lgan tirbandlik uzunligining aksinch o‘sishiga olib keladi. Berilgan bx_{add} va bx_{mult} qiymatlari diapazonida chorrahadan o‘tuvchi avtomobillar soni 17.5% va tirbandlik uzunligi 25% o’zgarishi aniqlandi. Demak, faqat haydovchining xatti-harakatlari natijaviy qiymatlarga 25% gacha ta’sir qilishi mumkin.

4. Xulosa

Ushbu maqolada chorrahalarni loyihalash uchun simulyatsiya qilish, kalibirovkani imkon qadar aniq qilish va real aniqlangan ko‘rsatkichlar bilan uyg‘unligi naqadar muhimligini ko‘rsatadi. Chorrahani kompyuter dasturlarida simulyatsiya qilib, kerakli o‘zgartirishlarni avval boshidan aniqlab olib, keyin amalda qo‘llash transport xarajatlarini kamaytirishiga olib keladi. Shuningdek, mavjud transport tarmoqlari samaradorligini oshishiga, atrof-muhitni saqlash va transport foydalanuvchilariga maksimal qulaylik yaratishda yordam bo‘ladi. Vidman 74 modelini qo‘llash orqali olingan natijalar berilgan bx_{add} va bx_{mult} qiymatlari diapazonida chorrahadan o‘tuvchi avtomobillar soni 17.5% va tirbandlik uzunligi 25% o‘zgarishi aniqlandi. Demak, faqat haydovchining xatti-harakatlari natijaviy qiymatlarga 25% gacha ta’sir qilishi mumkin va o‘z navbatida bu ko‘rsatkichlarni to‘g‘ri kalibrovkalsh zaruriyatini ko‘rsatadi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Ro‘zimov Sanjarbek Komilovich	Toshkent Kimyo xalqaro universiteti “Yo‘l harakati muhandisligi va boshqaruvi” kafedrasi professor vazifasini bajaruvchisi, E-mail: sanjar.ruzimov@gmail.com Tel.:+998998704117 https://orcid.org/0009-0001-6098-5775
O‘runov Dilshod Alimardon o‘g‘li	Toshkent davlat transport universiteti “Transport intellektual tizimlari muhandisligi” kafedrasi doktoranti, E-mail: dilshodorunov@gmail.com Tel.:+998939027922 https://orcid.org/0009-0003-0120-6166

Methodology for calculating atmospheric pollution by the motor transport complex in the Republic of Uzbekistan

B.I. Bazarov[1][a], A.A. Ernazarov[2][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan
[2]Jizzakh Polytechnic Institute, Jizzakh, Uzbekistan

Abstract: Environmental pollution by road transport in the regional centers of the Republic of Uzbekistan has been studied. The processes of movement of pollutants in two main planes – horizontal and vertical - are considered. It is determined that the industrial centers of the Republic of Uzbekistan and the centers of the regions have a fairly developed transport and road network with a different number of vehicles affecting the environmental situation. The amount of harmful substances moving with air masses from regional centers is calculated. It is determined that the sources of atmospheric pollution of the considered points, i.e. cities, are mainly motor vehicles, the total gross emission of pollutants from which depends on the amount of the rolling stock itself, the type and engine power of the type of fuel used.
Keywords: Road transport, ecology, environmental pollution, movement of air masses

Методика расчета загрязнения атмосферы автотранспортным комплексом в Республике Узбекистан

Базаров Б.И.[1][a], Эрназаров А.А.[2][b]
[1]Ташкентский государственный транспортный университет, Ташкент, Узбекистан
[2]Джизакский политехнический институт, Джизак, Узбекистан

Аннотация: Изучено загрязнение окружающий среды автомобильным транспортом в областных центрах Республики Узбекистан. Рассмотрены процессы движения загрязняющих веществ в двух основных плоскостях – горизонтальной и вертикальной. Определено, что промышленные центры Республики Узбекистане центры областей имеют достаточно развитию транспортно-дорожную сеть с разным количеством транспортных средств, влияющих на экологическую ситуацию. Рассчитано, количество вредных веществ, перемещающихся с воздушными массами из областных центров. Определено, что источниками загрязнения атмосферы рассматриваемых пунктов, т.е. городов является главным образом автомобильные транспортные средства, общий валовой выброс загрязняющих веществ от которых зависит от количества самого подвижного состава, типа и мощности двигателя применяемого вида топлива.
Ключевые слова: автомобильный транспорт, экология, загрязнение окружающий среды, перемещение воздушных масс

1. Введение

Загрязнение воздуха является одной из самых серьезных экологических угроз для здоровья человека. За счет мер по снижению уровня загрязнения воздуха страны могут уменьшить бремя болезней, таких как инсульт, болезни сердца, рак легких и хронические или острые респираторные заболевания, включая астму. В 2023 г. 99% мирового населения проживало в районах, в которых уровень загрязнения воздуха превышал значения, установленные в рекомендациях ВОЗ по качеству воздуха [1].

В крупных городах основным источником вредных веществ в атмосфере является автотранспортный комплекс. По некоторым оценкам среди источников загрязнения воздуха 50-80% приходится на автотранспорт. По другим данным автотранспорт является источником 30-70% общей массы выбросов. Таким образом, 40-75% загрязняющих веществ, попадающих в атмосферу, приходится на автотранспорт. В современном мире за счет постоянного развития технологий и облегчения процесса по производству дорожного транспорта происходит постоянный рост количества автомобилей. Так как люди в основном проживают в городах, то происходит заполнение всей территории города транспортом, и вследствие этого образуется зона повышенной концентрации вредных веществ. Некоторые из этих веществ оседают на дорогах, а другие поднимаются в

[a] https://orcid.org/0000-0002-3343-3932
[b] https://orcid.org/0000-0002-4188-2084

воздух, накапливаются в атмосфере и выпадают с осадками, загрязняя почву и воду.

Большой вклад в изучении загрязнения атмосферного воздуха автомобильно-дорожным комплексом внесли следующие исследователи: Исследования концентрации веществ, выделяемых в атмосферу автомобильным транспортом, в конкретных городах и странах рассмотрены в работах [2,3,4,5,6,7,8,9,10]. Проведены расчеты выбросов загрязняющих веществ, поступающих в атмосферный воздух от автомобилей. Оценка и анализ динамики загрязнения атмосферного воздуха автотранспортом и прогнозирование вероятных последствий приведены в работах [11,12]. Авторы этих работ на основе данных, которые были получены ранее, выявили наиболее негативное влияние, которое оказывает автомобильный транспорт на качество атмосферного воздуха. Основную долю в загрязнение атмосферы городов токсичными и вредными веществами вносит автотранспорт. Работы авторов, которые выявили, каким образом взаимосвязаны ландшафт и концентрация вредных веществ вблизи автомобильно-дорожного комплекса [13]. Приведены результаты определения концентрации взвешенных частиц и общей пыли, содержащихся в атмосферном воздухе вблизи автомобильных дорог. Рассмотрены зависимости загрязнения атмосферы выбросами двигателей внутреннего сгорания автомобилей от месторасположения и ландшафта. Определены зависимости между ровностью дорожного покрытия и выбросами загрязняющих веществ в атмосферу от автомобильно-дорожного комплекса. Влияние скоростного режима и плотности автомобильного потока на содержание загрязняющих веществ в атмосферном воздухе [14,15,16]. Выявлены зоны повышенного загрязнения на дорогах города и показатели, определяющие комплексное воздействие автотранспорта на уровень загрязнения городской среды. Проведен анализ скоростного режима проезда автомобильного транспорта и изменяющейся плотности автомобильного потока. В работах исследуется влияние загрязняющих веществ, выбрасываемых автотранспортом, на здоровье человека [17,18,19]. В результате проведенных исследований отмечается тесная зависимость многих заболеваний от содержания в атмосферном воздухе дорожной пыли. В настоящее время все больше людей обеспокоено проблемой охраны окружающей среды, так как именно от ее решения зависит здоровье и благосостояние их самих и будущих поколений.

2. Методология исследования

Распространение вредных веществ в атмосфере приводит к ухудшению экологической обстановки, увеличению частоты выпадения кислотных дождей, приводящих к закислению почвы, образуя некую зону загрязнения вокруг точечного источника выброса. Моделирование распространения вредного вещества в атмосфере и построение зоны загрязнения с привязкой к карте местности позволит оценить возможные последствия и ущерб от источников выбросов.

При попадании в воздух с отходящими газами, загрязняющие вещества двигаются в двух основных плоскостях – горизонтальной и вертикальной. Горизонтальный фактор определяет движение газов в плоскости земли с ветром. При этом скорость ветра влияет на разбавление вредных веществ и понижает их приземную концентрацию. Вертикальный фактор определяет движение отходящих газов вверх, при этом, чем температура газов выше температуры воздуха, тем значительнее вертикальный подъём выброса и хуже его рассеивание. На распространение вредных веществ в атмосфере влияют такие явления, как инверсия, изотермия, конвекция. Увеличение температуры воздуха повышает приземную концентрацию вредного вещества, а увеличение скорости ветра способствует быстрейшему его рассеиванию.

Предположим, что существуют и известны верхние пределы концентрации загрязнений атмосферы с участием АТС, т.е. приемлемы значения для различных пунктов.

Пусть имеются n пунктов $u_1, u_2, \dots u_n$. в дискретные моменты времени $t = 0,1,2, \dots$ в пункте u_1 концентрация загрязняющего вещества равна $C_i(t)$. За единичный период времени некоторая доля q_{ij} загрязняющего вещества из пункта u_i переносится в пункт u_j . Числа q_{ij} зависят от географических, метеорологических и других аналогичных условий и в принципе должны быть различными для разных временных периодов.

Значения q_{ij} удовлетворяют условию $\sum_{j=1}^{n} q_{ij} \leq 1$. Оно означает, для каждого из пунктов u_i, загрязняющее вещество может быть рассеяно или перенесено в другой из рассматриваемых пунктов. Однако в данной модели предполагается, что выйдя за пределы системы пунктов u_i, загрязнения обратного не возвращаются к исходному пункту.

Введем воображаемый пункт u_0, куда собираются потоки рассеивающихся загрязнений, и считаем, что, попав в u_0, частицы загрязнения там и остаются. Тогда можно расширить матрицу Q размерности $n \times n$ и получить стохастическую матрицу P размерности $(n+1) \times (n+1)$ путем добавления нулевой строки вида (1,0,0,..,0) и нулевого столбца, элементы которого выбраны так, чтобы сумма строк матрицы P были равны единиц 1

Можно рассматривать матрицу P_b в качестве переходной матрицы некоторой цепи Маркова и в этой цепи u_0 является поглощающим состоянием. [20]

Следуют также предположить, что P определяет поглощающую цепь с единственным поглощающим состоянием u_0. Это предложение выполнимо, если для всех i имеет место

$\sum_{j=1}^{n} q_{ij} < 1$ (1)

Согласно данному условию в каждой точке u_i, происходит в любом временном интервале рассеивание загрязняющих веществ.

Пусть в некоторых из пунктов $u_1, u_2, \dots u_n$, расположены источники загрязнений атмосферы. За единичный период времени источник загрязнений, расположенный в точки u_i, выбрасывает некоторое число $f_i \geq 0$ загрязняющих веществ. Если в точке u_i, отсутствует источники загрязнений, положим $f_i = 0$ кроме того, возьмем $f_i = 0$. Для упрощения полагаем, что f_i не зависит от времени.

Задача заключается в том, что какие ограничения или верхние пределы должны быть указаны в каждом из источников пока с не известным их количеством m_i загрязняющего вещества в пункте u_i, в момент $t_0 = 0$,

для выброса f_i число загрязняющих веществ с тем, чтобы не превзойти допустимые границы концентрации загрязняющих веществ. Эти ограничения могут зависеть от уровня загрязнений в момент введения нового стандарта.

Обозначим допустимый верхний уровень концентрации загрязнения числом g_i. Необходимо выбрать $т_i$ таким образом, чтобы после некоторого времени $C_i(t) \le g_i$ для всех i. Пусть $f = (f_1, f_2, \ldots, f_n)$, $g = (g_1, g_2, \ldots, g_n)$, $m = (m_1, m_2, \ldots, m_n)$ и $C(t) = (C_1(t), C_2(t) \ldots . C_n(t)$.

Из общего количества m_i загрязняющего вещества, находившегося в точке $u_i (i \neq 0)$ в момент $t = 0$, некоторая часть, а именно, $m_i \cdot \rho_{i_j} = m_i q_{ij}$ переходит в точку $u_j (j \neq 0)$ к моменту $t = 1$. Следовательно, если никаких дополнительных загрязнений не поступает, их распределение в момент $t = 1$ определяется вектором mQ. Таким образом, $C(1) = mQ$. Аналогично распределение загрязнений к моменту $t = 2$, C(2) определяется вектором $mQ,^2 \ldots$, распределения загрязнений к моменту t - вектором $mQ,^t$.

Для поглощающей цепи Маркова с переходной матрицей, представленной в канонической форме, справедливы следующие утверждения: $Q' \to 0$ и матрица $(J - Q)$ имеет обратную матрицу, а также так как матрица Q получена для поглощающей цепи Маркова, то из вышесказанного утверждения следует, что $Q^t \to 0$. Поэтому и $mQ^t \to 0$. Таким образом, можно заключить что если не поступает дополнительные загрязняющие вещества, то начальная концентрация ввиду рассеивания со временном уменьшается до незначительных размеров, т.е. все загрязняющие вещества поглощаются со временем воображаемым пунктом u_0.

3. Результаты исследования

Рассмотрим конкретный пример, известно, что главными промышленными центром Республики Узбекистан являются центры областей, имеющие достаточно развитию транспортно-дорожную сеть с разным количеством транспортных средств. По политической карте определяем географические места расположения этих центров и для каждого из них построим схему розы ветров, основываясь на научных источниках (рис.1, табл. 1).

Таблица 1

Годовое повторение направление ветра в Областных центрах Республики Узбекистан

№	Направление ветра, %								
	Города республики	Северный	Севера - восточный	Восточный	Юго - восточный	Южный	Юго-западный	Западный	Севера западный
1	Нукус	20	33	12	8	4	5	8	10
2	Ургенч	13	37	14	5	3	5	11	12
3	Бухара	44	8	8	7	5	6	6	16
4	Навои	12	13	41	6	5	5	10	8
5	Карши	20	9	26	5	6	6	11	17
6	Термез	4	18	11	10	7	30	16	4
7	Самарканд	6	8	34	27	2	5	10	8
8	Джизак	20	9	5	1	2	9	37	17
9	Гулистан	8	8	17	19	15	12	12	9
10	Ташкент	17	24	15	7	6	5	8	18
11	Фергана	14	8	6	22	14	5	15	15
12	Наманган	29	11	11	9	8	11	5	16
13	Андижан	2	4	50	13	8	16	5	2

При изображении розы ветров на рис. 1. выбран масштаб 1мм=2%.

Как видно из рис. 1. Имеется 13 пунктов. Из каждого пункта в другую переносится некоторая доля загрязняющего вещества за единичный период времени. Считая, что годовая средняя скорость ветра для всех пунктов постоянной и равны между собой, и учитывая расстояния между пунктами по направлению розы ветров, получим следующий вид матрицы Q (табл. 2).

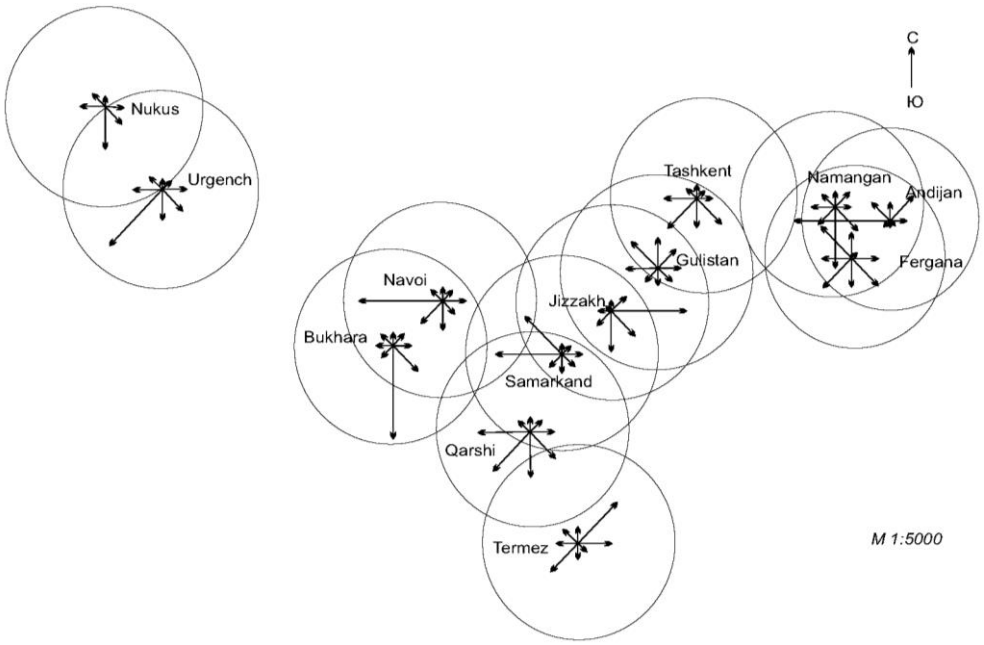

Рис. 1. Географическое положение областных центров Республики Узбекистан

Таблица 2

Матрица Q

$$Q = 10^{-2} \times \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 7 & 0.2 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.38 & 13 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 22 & 0.6 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.4 & 6 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 16 & 0 & 0.85 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.3 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 11 & 1.12 & 0 & 8 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 11 & 0.47 & 6 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 18.6 & 0.12 & 16 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 4.69 & 13 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 24 & 9 & 0.31 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 19 & 0.75 & 14 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.9 & 9 & 11 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

На основе матрицы Q построена матрица P

Таблица 3

$$P^T = 10^{-3} \times \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 868 & 2 & 130 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 926.2 & 70 & 38 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 934 & 0 & 0 & 6 & 6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 776 & 0 & 0 & 220 & 4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 911.5 & 0 & 0 & 0 & 0 & 8.5 & 0 & 80 & 0 & 0 & 0 & 0 & 0 \\ 997 & 0 & 0 & 0 & 0 & 0 & 3 & 0 & 0 & 0 & 0 & 0 & 0 \\ 767.8 & 0 & 0 & 0 & 0 & 160 & 0 & 11.2 & 60 & 0 & 0 & 0 & 0 \\ 725.3 & 0 & 0 & 0 & 0 & 0 & 0 & 110 & 4.7 & 160 & 0 & 0 & 0 \\ 758.8 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 110 & 1.2 & 130 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 186 & 46.9 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 3.1 & 140 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 90 & 7.5 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 240 & 190 \end{pmatrix} \quad \begin{matrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 110 \\ 90 \\ 9 \end{matrix}$$

Зная величины коэффициента диффузии газов, например углекислоты CO_2 в воздух при O °C. ($\boldsymbol{D} = \mathbf{0,142}\text{см}^2/\text{с}$) определим скорость распространения вредного вещества $\boldsymbol{V_D} = \mathbf{0,377}\text{см/с} = \mathbf{0,0136}\,^{\text{км}}/_{\text{час}}$.

Принимаем средняя скорость ветра равным $\boldsymbol{V_в = 10}$м/с $= \mathbf{36}\,^{км}/_{час}$.

Из географического положения городов на карте (рис. 1.) заметим расстояние между двумя сосенно расположивших центров, например между Нукусом и Ургенчем, которое является радиусом действия распространенных вредных веществ в атмосфере, *CO* суммарной скоростью $\boldsymbol{V_с = V_D + V_в = 36,00136}\,^{км}/_{час}$ Измерив расстояние между центрами городов $R = 125$км, определим время, израсходованное на преодоления указанного расстояния, которое равно $\boldsymbol{t_1 = R/V_с = 3,47}$час.. Значить t_1 является действительным значением дискретных моментов времени $(\boldsymbol{t_1 = 0; 3,47; 6,94}; \ldots\ldots)$

Площадь равномерного распространения вредных веществ, определяется как $\boldsymbol{S = \pi R^2 = 3,14 \cdot (125)^2 = 49062}$км^2; Из географического справочника определяется площадь каждого города $\boldsymbol{S_r}$ в включенного в списке изучаемых объектов. Затем из соотношения S_r/S устанавливаем, что какая доля вредных веществ остается в начальном пункте, так как условие $\sum_{j=1}^{n} q_{ij} \leq 1$ означает, что для каждого из пунктов, загрязняющее вещество может быть рассеяно или перенесено в другой из рассматриваемых пунктов.

Источниками загрязнения атмосферы рассматриваемых пунктов, т.е. городов является главным образом автомобильные транспортные средства, общий валовой выброс загрязняющих веществ от которых зависит от количества самого подвижного состава, типа и мощности двигателя применяемого вида топлива и т.д.

4. Выводы

Исходя из анализа полученных результатов рассеивания загрязняющих веществ на территории города целесообразно выполнение следующих мероприятий:

1. Обновление городского автопарка путем перевода на газ общественного транспорта и коммунальной техники и создание инфраструктуры для заправки газобаллонных автомобилей.

2. Перепланировка транспортного движения и его структуры на долговременный период и отдельные часы суток.

3. Выбор оптимальных градостроительных решений, связанных со строительством транспортных развязок, определением архитектурно-планировочных характеристик строящихся и реконструируемых автомагистралей.

5. Систематическое проведение натурных обследований автотранспортных потоков и последующее проведение расчетов выбросов рассеивания загрязняющих веществ в приземном слое атмосферы.

6. Планомерный отбор проб атмосферного воздуха для определения концентраций приоритетных загрязняющих веществ (диоксид азота и оксид углерода) вблизи наблюдаемых автомагистралей.

7. Проведение сводных расчетов загрязнения воздушного бассейна города с учетом выбросов промышленности и автотранспорта.

По итогам проведенных расчетов подготовлена электронная база данных об уровне загрязнения атмосферного воздуха областных центров, получены карты пространственного распределения выбросов загрязняющих веществ от автотранспорта и предприятий автотранспортного комплекса, установлены приоритетные загрязняющие вещества. По итогам анализа выработаны предложения по снижению негативного воздействия от выбросов автотранспорта и дальнейшей оценки качества атмосферного воздуха города.

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Информация о авторах/ Information about the authors

Базаров Бахтиёр Имамович	Ташкентский государственный транспортный университет, доктор технических наук, профессор кафедры "Транспортные энергетические установки" baxtbb@mail.ru, Тел.: +998946499275 https://orcid.org/0000-0002-3343-3932
Эрназаров Азиз Алибаевич	Джизакский политехнический институт, доцент кафедры «Инженерия транспортных средств». aziz-ernazarov@mail.ru, Тел.: +998939404123 https://orcid.org/0000-0002-4188-2084

Automation of warehouse stock management

T. Nurmukhamedov[1][a], J. Gulyamov[1][b], A. Azimov[1][c]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: The structure of the inventory management system of the wagon depot is proposed. The relationships and factors influencing the automation of warehouse inventory management are analyzed and defined. The dynamics of inventory turnover for past periods, necessary for repair and equipment work with passenger cars, and the performance of team work are studied.
Keywords: wagon, goods, depot, stock, structure, flow, repair, team, automation, management, object

Автоматизация управления складскими запасами

Нурмухамедов Т.[1][a], Гулямов Ж.[1][b], Азимов А.[1][c]
[1]Ташкентский государственный транспортный университет, Ташкент, Узбекистан

Аннотация: Предложена структура системы управления запасами вагонного депо. Проанализирована и определены отношения, факторы влияющие на автоматизацию управления складскими запасами. Изучена динамика оборачиваемости товарных запасов за прошедшие периоды, необходимых при ремонтно-экипировочных работах с пассажирскими вагонами, и выполнения бригадной работы.
Ключевые слова: вагон, товар, депо, запас, структура, поток, ремонт, бригада, автоматизация, управление, объект

1. Введение

В последнее время Акционерное общество «Узбекистон темир йуллари» разрабатывает и внедряет в различные технологические процессы, связанные как с ремонтно-экипировочными работами (РЭР) транспортных единиц, так и обеспечения равномерности самих перевозок автоматизированных информационно-управляющих систем (АИС). Управление складами вагонного депо невозможно без наблюдения, анализа и, как следствие, совершенствования системы передачи информации о наличии товарно-материальных ценностей (ТМЦ) используемых РЭР, которую можно отнести к сложной экономической структуре, и обратной связи - состояния и наличия запасов, работы складов, и т.д., которая необходима для своевременного и оптимального их (запасов) пополнения. Использование информационных ресурсов, базы данных в различных технологических процессах, обеспечивающих бесперебойный перевозочный процесс, в том числе и создания оптимальных запасов, направленные на выравнивание ритма РЭР в пассажирской службе, являются весьма актуальными.

2. Основная часть

В связи с кардинально изменившейся системой экономических отношений в республике возникла необходимость эффективной организации управления запасами ТМЦ с целью обеспечения финансовой стабильности в целом железной дороги. Прежде всего, в различных возникающих ситуациях необходимо в полной мере использовать возможности передачи информации по каналам связи, использования современного компьютерного оборудования и информационных технологий, которые позволяют быстро просчитывать последствия любых управленческих действий. В современных условиях повышение эффективности управления ТМЦ на складе депо неразрывно связано с эффективным использованием компьютеров, сбором и обработкой данных, созданием базы данных, отражающей полное состояние складских запасов. Это достигается за счет использования соответствующих математических моделей и современных технологий программирования, а также разработки численно-аналитических алгоритмов.

Связующим звеном цепочки управления является информация, а ее полнота, надежность, последовательность и своевременность поступления на исполнительный орган способствуют качеству приема управленческих решений. Исходя из определения понятия "управление", можно выделить две подсистемы: управляемый (объект управления) и управляющий (орган управления). На рисунке 1 показана расширенная структура системы управления

[a] https://orcid.org/0000-0002-2507-3674
[b] https://orcid.org/0000-0003-1984-9111
[c] https://orcid.org/0000-0003-4240-759X

запасами склада вагонного депо.

Сокращения рисунка:

- P_1 - товарный поток;
- P_2 – информация поступающая из обратной связи о товарах, введенных в базу данных;
- P_3 - информация об полученных и учтенных складских товарах;
- P_4 - информационный поток из нижней системы управления в верхнюю;
- P_2 - информация о заказах из производственных цехов;
- U_1, U_2, U_3 - управляющие воздействия, передаваемые от верхнего органа управления к среднему и нижнему.

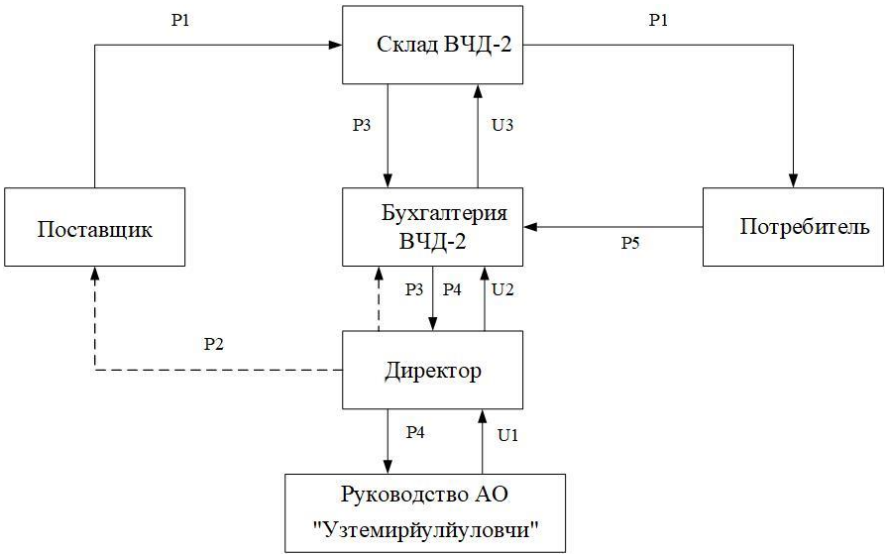

Рисунок 1. Расширенная структура системы управления запасами

При изучении и анализе существующей системы управления склада уделено внимание следующим аспектам:

- анализ основных задач, выполняемых системой;
- степень соответствия системы управления задачам эффективного выполнения перевозочных процессов железнодорожным транспортом;
- действия, направленные на совершенствование технологии и организации перевозочного процесса;
- мерам, направленным на совершенствование системы управления.

Рассмотрены аспекты процесса управления, связанные с характером организации формирования складских запасов:

- проанализирован процесс формирования запасов с целью определения наиболее важных характеристик и закономерностей объекта управления;

- выполнен анализ системы управления, в частности, методов и функций управления, процессов принятия решений, организации системы управления, в статике и динамике.

Автоматизированная система управления запасами - ***АСУЗ***, в которой одновременно задействованы люди и технические средства, обеспечивающие управление запасами, должна основываться на следующей взаимосвязи:

АСУЗ $f(x_i)$; $\Rightarrow$ 2, 3,…

Здесь x_1 - количественные и качественные показатели запасов;

x_2 – нормативно-информационные данные для расчета необходимого объема запасов;

x_3 - данные о техническом оснащении складов;

x_4 - информация о пассажирских вагонах;

x_5 - данные о выполнении РЭР с вагонами;

x_6 - информация о технические устройствах и их состоянии, задействованных в РЭР;

x_7 - статистические данные о вагонах за период времени m;

x_8 - информация о частоте заказов на товары и материалы.

Задача АИС складскими запасами является определение оптимального их количества, которое должно соответствовать следующим требованиям:

- функционирование автоматизированной системы должно основываться на современных экономических критериях с учетом ограничения допустимого времени для реализации РЭР;

- принятию обоснованных решений по управлению ТМЦ;

- повышению эффективности оперативного управления ТМЦ при возникающих спросах на запасы;

- переходу на непрерывную систему оперативного управления запасами с учетом современных возможностей развития информационных технологий;

- снижению затрат железной дороги, связанные с обработкой и парковкой пассажирских вагонов в депо.

Выполненный анализ состояния управления складскими запасами, позволяет сделать вывод о том, что, несмотря на значительные результаты, достигнутые в области создания систем управления запасами, модели, алгоритмы на данный момент не в полной мере отвечают современным требованиям. Относительно вагонного депо можно отметить, что в настоящее время учет ТМЦ на складе выполняются вручную, не разработаны современные методы считывания информации о поступающих товарах.

Выше отмеченное позволяет сделать вывод о

необходимости своевременного пополнения запасов на основе научно обоснованных методов управления ими (запасами), созданием моделей, алгоритмов и считывания данных о поступающих на склад ТМЦ и записи информации в базу данных с целью автоматизированного управления складскими запасами. Предоставление комплектующих и различных товаров при выполнении РЭР в вагонном депо ВЧД-2 обеспечивается тремя основными складами, действующими на предприятии, с необходимым оборудованием для ремонта и выполнения работ сотрудниками цехов с пассажирскими вагонами и подготовки их к рейсам.

Ниже представлена диаграмма поступления ТМЦ на склад №1, который предоставляет товары для выполнения РЭР с вагонами за 2023 год (рисунок 2). Данный рисунок отражает также обороты запасов за этот период.

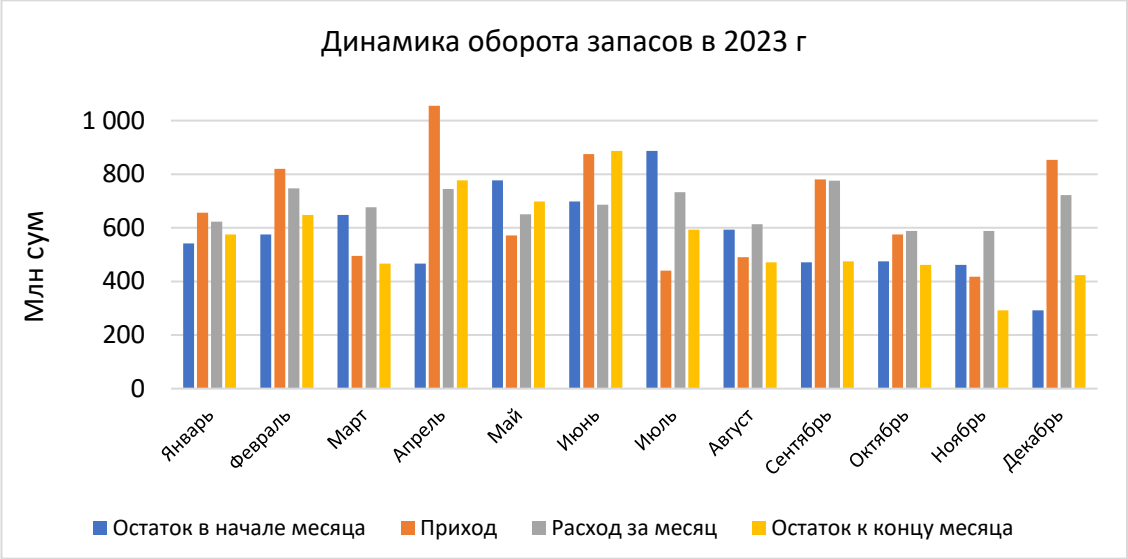

Рисунок 2. Динамика складского товарооборота в 2023 году

Анализ представленных диаграмм позволил сделать следующие выводы: - потребность в запасах при выполнении РЭР с пассажирскими вагонами бригадами цехов вагонного депо ВЧД-2 является переменной;

- наблюдается изменчивость объемов запасов, количество складских запасов высокая, что в свою очередь влияет на увеличение времени их (запасов) хранения, выведения денежных средств из оборота;

- временной ряд показывает, что требования к сезонным запасам возрастают в основном в сентябре и декабре.

Полученные результаты позволят заключить, что при разработке моделей управления запасами необходимо обратить внимание на следующее:

- для того, чтобы объем запасов был оптимальным, в каком количестве необходимо заказывать ТМЦ;

- на какой период года необходимо выполнять заказы. Ниже приведена диаграмма динамики спроса на запасы (рисунок 3).

Рисунок 3. Динамика потребности в запасах вагонного депо

Из диаграммы видно, что требования к запасам представленный по месяцам, в 2023 году возрос (в сравнении с другими годами). Надо отметить, что объем складских запасов характеризуется выравниванием, т.е.

нормализованы.

3. Заключение

1. Анализ выполненного исследования управления складскими запасами показывает, что основными недостатками является определение оптимального количества и обеспечения возможности хранения на складах.

2. Автоматизация учетной работы склада вагонного депо предусматривает автоматизацию оформления документов - возможность определять ввод и вывод товаров, оборачиваемость, и все это дает возможность эффективно использовать складские площади, уменьшение работы с товарами сокращает время проведения операций, развитие системы учета. организация, формирующая рабочее место с использованием современных технических средств.

3. Существующие системы складского учета вагонного депо акционерного общества "Ўзтемирйўлйўловчи" не учитывают товарные запасы, а это в свою очередь не позволяет эффективно выполнять ремонтно-экипировочные работы и организовать работу бригад цехов. Определена необходимость создания АИС позволяющая оптимально управлять запасами, перети на безбумажную технологию выполнения учетно-бухгалтерских операций.

4. Автоматизированная система управления складом обеспечит эффективное управление процессом выполнения РЭР бригадами, приведет к качественным изменениям в процессах планирования и управления, оптимизации и ускорению ремонтных работ с учетом интенсивности перевозочного процесса.

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Информация о авторах/ Information about the authors

Nurmuxamedov Tolaniddin Ramziddinovich	Toshkent davlat transport universiteti “Transportda axborot tizimlari va texnologiyalari” kafedrasi t.f.d., professori. E-mail: ntolaniddin@mail.ru Tel.:+99890 927-27-92 https://orcid.org/0000-0002-2507-3674
Gulyamov Javlon Nurullayevich	Toshkent davlat transport universiteti “Transportda axborot tizimlari va texnologiyalari” kafedrasi Ph.D., dotsent v.b. E-mail: javlonbek1207@gmail.com Tel.:+99893 546-14-27 https://orcid.org/0000-0003-1984-9111
Azimov Abdulxay Abdulatifovich	Toshkent davlat transport universiteti “Transportda axborot tizimlari va texnologiyalari” kafedrasi assistenti. E-mail: azimovabdulhay1915@gmail.com. Tel.:+99890 941-17-18 https://orcid.org/0000-0003-4240-759X

Evaluation of the impact of manual transmission vehicles on intersection capacity on urban arterial streets

J.A. Choriev[1][a], E. Fayzullaev[1][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: This study focuses on examining the impact of vehicles with manual transmissions on the intersection capacity of urban arterial streets. Vehicles with manual transmissions are widely used in traffic, but their impact on traffic flow is under-researched. The main goal of the study is to evaluate the delay times and fuel consumption of vehicles with manual transmissions during the initiation of movement within a traffic flow composed of such vehicles. The relevance of the research is due to the need for effective management of the growing traffic flow in cities and improving its efficiency. Notably, the prolonged reaction time of vehicles with manual transmissions at intersections leads to a slowdown in traffic flow and a decrease in intersection capacity. The study employs methods from transportation engineering, traffic theory, and statistical analysis. Specifically, the delay times and fuel consumption of vehicles with manual transmissions at intersections were assessed. The results show that vehicles with manual transmissions significantly impact traffic flow, particularly in the process of clearing intersections, leading to reduced capacity. These findings can be applied to improve traffic management systems and organize efficient movement at intersections. In conclusion, this study can help develop practical recommendations for reducing delay times and fuel consumption in cities with a high presence of vehicles with manual transmissions, contributing to increased intersection capacity and improved urban traffic flow. The study's findings have significant practical applications in transportation engineering and traffic management and can contribute to the development of urban infrastructure.

Keywords: Arterial street, intersection capacity, manual transmission, vehicle, traffic flow, traffic management

Shahar magistral ko‘chalarida mexanik transmissiyali avtotransport vositalarining chorrahalar o‘tkazuvchanligiga ta’sirini baholash

Choriyev J.A.[1][a], Fayzullaev E.[1][b]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Mazkur tadqiqot shahar magistral ko‘chalarida mexanik transmissiyali avtotransport vositalarining chorrahalar o‘tkazuvchanligiga ta’sirini o‘rganishga qaratilgan. Mexanik transmissiyali transport vositalari yo‘l harakatida keng qo‘llaniladi, ammo ularning transport harakat oqimiga ta’siri kam o‘rganilgan. Tadqiqotning asosiy maqsadi harakat tarkibi mexanik transmissiyali transport vositalaridan iborat bo‘lgan transport oqimining harakatlanishni boshlash jarayonida avtomobillar orasidagi oraliq qo‘zg‘alish reaksiya vaqtlarining avtotransport vositalarining kechikish vaqti va yoqilg‘i isrofini baholashdan iborat. Tadqiqotning dolzarbligi shaharlarda jadallik bilan o‘sib borayotgan transport oqimini boshqarish va uning samaradorligini oshirish zarurati bilan belgilanadi. Ayniqsa, mexanik transmissiyali avtotransport vositalarining chorrahalarda qo‘zg‘alishdagi uzoq davom etadigan reaksiya vaqti transport oqimining sustlashishiga va chorraha o‘tkazuvchanligining pasayishiga sabab bo‘luvchi muammo hisoblanadi. Tadqiqotda transport muhandisligi, yo‘l harakati nazariyasi va statistik tahlil usullari qo‘llanildi. Shu jumladan, chorrahalarda mexanik transmissiyali avtotransport vositalarining kechikish vaqti va yoqilg‘i isrofi baholandi. Olingan natijalar shuni ko‘rsatdiki, mexanik transmissiyali avtotransport vositalar, ayniqsa, chorrahalardagi harakat jarayonida transport harakat oqimiga sezilarli ta’sir o‘tkazdi, bu esa transport oqimining chorrahani bo‘shatish jarayonining sustlashishiga va o‘tkazuvchanlikning kamayishiga olib keladi. Natijalar transport oqimini boshqarish tizimlarini takomillashtirishda, chorrahalarda harakatni samarali tashkillashtirishda qo‘llanilishi mumkin. Xulosa qilib aytish mumkinki, ushbu tadqiqot mexanik transmissiyali avtotransport vositalari ishtiroki ko‘p bo‘lgan shaharlarda kechikish vaqti va yoqilg‘i isrofini samarali kamaytirish bo‘yicha amaliy tavsiyalar ishlab chiqishga yordam beradi. Bu esa yo‘l o‘tkazuvchanligini oshirish va shaharlardagi transport oqimini yaxshilashga xizmat qiladi. Tadqiqot natijalari transport muhandisligi va yo‘l harakatini boshqarish sohasida muhim amaliy qo‘llanishga ega bo‘lib, ular shahar infratuzilmasini rivojlantirishga o‘z hissasini qo‘shishi mumkin.

[a] https://orcid.org/0009-0009-9975-7444
[b] https://orcid.org/0009-0007-6294-9392

Kalit so‘zlar: Magistral ko‘cha, chorraha o‘tkazuvchanligi, mexanik transmissiya, avtotransport vositasi, transport oqimi, yo‘l harakatini boshqarish

1. Kirish

Shaharlarda transport oqimini boshqarish va chorrahalarning o‘tkazuvchanligini optimallashtirish zamonaviy shaharsozlik va transport muhandisligida muhim masalalardan biridir. Shu jumladan “Avtomobil transportini boshqarish tizimini yanada takomillashtirish chora-tadbirlari to‘g‘risida” O‘zbekiston Respublikasi Prezidentining 2018-yil 6-martdagi PQ-3589-son qarori tadqiqotning dolzarbligini oshiradi [1]. Jadal rivojlanayotgan shaharlarda transport oqimining ko‘payishi, chorrahalarda yuqori hajmdagi transport vositalari bilan bog‘liq muammolarni keltirib chiqarishi mumkin. Mexanik transmissiyali avtotransport vositalari shahar yo‘llarida keng qo‘llaniladi, ammo ularning transport oqimining kechikish vaqtiga va atrof muhitga chiqaradigan ortiqcha chiqindi gazlar miqdorining oshishiga bo‘lgan ta’siri aniq va to‘liq tadqiq qilinmagan. Ushbu tadqiqot, mexanik transmissiyali avtomobillarning chorrahalardagi o‘tkazuvchanlikka qanday ta’sir ko‘rsatishini o‘rganish va tahlil qilish bilan shug‘ullanadi, bu esa shaharlardagi transport oqimini samarali boshqarish va ishlab chiqish uchun muhim ahamiyatga ega.

Mexanik transmissiyali avtotransport vositalari va ularning transport oqimiga ta’siri bo‘yicha bir qancha tadqiqotlar olib borilgan. Masalan, mexanik transmissiyali avtomobillarning tormozlanish va tezlanishning transport oqimiga ta’sirini (J.Lee, K.Heo, 2016), mexanik transmissiya va haydovchi xatti-harakatining o‘zaro bog‘liqligini (S.P.Hoogendoorn, W.Daamen, 2017), mexanik transmissiyali avtomobillar shahar chorrahalarida transport oqimi zichligini oshirishini (A.Habib, A.K.Tiwari, 2017), mexanik transmissiyali avtomobillarning uzatmalar qutisi o‘rnini tahlili (Y.Nakayama, T.Arakawa, 2018) va (Fayzullaev E.Z., Abduraxmanov R.A., Raxmonov A.S., 2019), (A.Khodaii, H.Shamshirband, 2015) (L.Sun, X.Liu, 2018), (T.Ohta, H.Nakano, 2019), (M. Kutzbach, R.Wang, 2019), (H.Mahmassani, S.Vlahogianni, 2020), (K.Iryo-Asano, T.Yoshii, 2020), (R.Gartner, C.Wagner, 2021), (D.Parker, J.Ward, 2021), (F.Chiaradia, L.Dell’Olio, 2022), (E.Taniguchi, A.Shimazaki, 2022), (B.A.Diop, S.Y.Kim, 2022), (A.P.Bayen, G.Gomes, 2023), (C.Hall, M.Greenfield, 2023), (P.Wagner, A.Borkowski, 2023), (N.G.Shaddock, R.S.Forbes, 2024), (L.Bessler, H.Weidenfeld, 2024) kabi tadqiqotchilar transport oqimini modellashtirishda simulyasiya usullarini, transport harakatini tahlil qilishda statistik va eksperimental uslublarni qo‘llagan. Shunday bo‘lsa-da, mexanik transmissiyali avtotransport vositalariga xususiy ta’riflangan tadqiqotlar yetarli darajada mavjud emas. Ba’zi tadqiqotlarda, mexanik transmissiyali transport vositalarning ta’siri umumiy transport oqimining tahlili orqali baholangan, ammo ularning chorrahalardagi xususiy ta’siri kam o‘rganilgan.

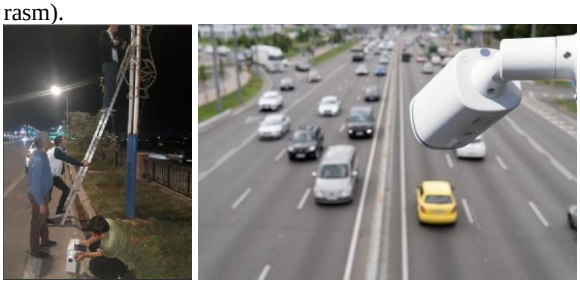
Adabiyotlarni tahlil qilish natijasida aniqlangan kamchiliklarning ba’zilari mana shunday: mexanik transmissiyali transport vositalari chorrahada turgan vaqtda xarakatni boshlagunga qadar sarflagan reaksiya vaqtlarining transport oqimining kechikish vaqti va yoqilg‘i isrofi miqdorlarini oshishiga ta’sirini baholash bo‘yicha tadqiqotlar olib borilmagan. O‘rganilmagan muammolar orasida, mexanik transmissiyali transport vositalarining chorrahalardagi harakat jarayoniga ta’siri va ularning transport oqimini qanday buzishi, shuningdek, bu holatning transport infratuzilmasidagi salbiy ta’sirlari to‘liq o‘rganilmaganligi mavjud. Shuning uchun, mavjud tadqiqotlar asosida ishlab chiqilgan yechimlarning samaradorligi va ularning amaliy qo‘llanilishi to‘liq ko‘rib chiqilmagan.

Aniqlangan muammolar asosida tadqiqotning asosiy maqsadi mexanik transmissiyali avtotransport vositalarining shahar magistral ko‘chalaridagi chorrahalarda turgan holda ularning harakatni boshlagunga qadar haydovchilarning sarflagan reaksiya vaqtlarining transport oqimining kechikish vaqti va yoqilg‘i isrofi miqdorining oshishini baholashdan iborat. Bu maqsadga erishish uchun tadqiqotda mexanizmlarni va metodologiyalarni ishlab chiqish, ularning samaradorligini baholash va amaliy tavsiyalarni taklif qilish nazarda tutiladi. Tadqiqot natijalari shaharlarda transport oqimi vujudga keltiradigan tirbandliklar darajasini kamaytirish choralarini, chorrahalardagi o‘tkazuvchanlikni yaxshilash va atrof-muhitga beradigan ekologik zararini kamaytirishga xizmat qiladi. Shu bilan birga, tadqiqot transport muhandisligi va yo‘l harakatini boshqarish sohasida qo‘llanilishi mumkin bo‘lgan amaliy tavsiyalarni ishlab chiqishga yordam beradi.

2. Tadqiqot metodikasi

Tadqiqot shuningdek, mexanik transmissiyali avtotransport vositalarining chorrahalardagi o‘tkazuvchanlikka ta’sirini aniqlash, transport oqimining kechikish vaqti va yoqilg‘i isrofi miqdorini baholash maqsadida amalga oshirildi. Tadqiqot 2023 yilning sentyabr oyida, Qarshi shahar magistral ko‘chalaridagi chorrahalarda o‘tkazildi.

Tadqiqotning amalga oshirilishi davomida, shahar miqyosida harakatlanuvchi transport vositalari va chorrahalardagi transport oqimining miqdori o‘rganildi (1-rasm).



1-rasm. Transport oqimi miqdorini o‘rganish uchun o‘lchov kameralarini o‘rnatish jarayoni

Tadqiqotlar aniqlangan chorrahalarda tadqiqot uchun belgilab olingan va texnik xizmat ko‘rsatish bo‘yicha professional kadrlar va transport muhandislari tomonidan amalga oshirildi.

Tadqiqot natijalarini tahlil qilish uchun statistik metodlardan foydalanildi. Olingan ma’lumotlar asosida tadqiqotning ob’yekti bo‘lgan 23 ta chorrahalardagi transport oqimi parametrlari o‘rganildi va tahlil qilindi, ular asosida transport oqimining samaradorligini baholash uchun usullar ishlab chiqildi. Boshqa tadqiqotlardan o‘rganilgan

ma’lumotlar bilan solishtirilib, mexanik transmissiyali transport vositalarining chorrahalardagi ta’siri hisoblandi.

Birinchi navbatda chorrahaning svetofor qizil chirog‘ida turgan transport oqimining bitta yo‘l bo‘lagi qatorida turgan n-chi transport vositasining svetofor yashil chirog‘i yongan vaqtdan boshlab kechikish vaqti quyidagi formula orqali hisoblandi:

$$T_n = (n-1)\cdot t_r \ (1)$$

Bu yerda: T_n – n-chi mexanik transport vositasining svetofor yashil chirog‘i yongan vaqtdan boshlab kechikish vaqti, n – n-chi o‘rindagi mexanik transport vositasi, t_r – mexanik transport vositasining harakatni boshlash uchun ketgan haydovchining reaksiya vaqti.

Transport oqimining bitta yo‘l bo‘lagida turgan transport vositalarining umumiy kechikish vaqti quyidagi formula orqali hisoblandi:

$$T_P = \sum_{T_n}^{T_1} \frac{(n-1)\cdot n\cdot t_r^2}{2} = \sum_{T_n}^{T_1} \frac{T_n\cdot n\cdot t_r}{2} \ (2)$$

Bu erda: T_P – transport oqimining bitta yo‘l bo‘lagida turgan transport vositalarining umumiy kechikish vaqti, n – n-chi o‘rindagi mexanik transmissiyali transport vositasi, t_r – mexanik transmissiyali transport vositasining harakatni boshlash uchun ketgan haydovchining reaksiya vaqti.

Bitta chorrahaning bir svetofor sikli davomida transport oqimining umumiy kechikish vaqti quyidagi formula orqali hisoblandi:

$$W = \sum_{T_{P_m}}^{T_{P_1}} \left(\sum_{T_{n_{P_m}}\cdot n_{P_m}}^{T_{n_{P_1}}\cdot n_{P_1}} \cdot \frac{t_r}{2} \right) (3)$$

Bu yerda: W – bitta chorrahaning bir svetofor sikli davomida transport oqimining umumiy kechikish vaqti, T_P – transport oqimining bitta yo‘l bo‘lagida turgan transport vositalarining umumiy kechikish vaqti, m – bitta chorrahaning jami yo‘l bo‘laklari soni, t_r – mexanik transmissiyali transport vositasining harakatni boshlash uchun ketgan haydovchining reaksiya vaqti, n – n-chi o‘rindagi mexanik transmissiyali transport vositasi.

Yuqorida keltirilgan formulalar tadqiqot ob’yekti bo‘lgan 23 ta chorrahalardan olingan transport oqimi parametrlarining mos qiymatlari (1-jadval) orqali qo‘llanildi.

1-jadval

Chorrahalardagi transport oqimi parametrlari

T/r	Chorraha nomi	m – yo‘l bo‘laklari soni	$n_{P_1}\ldots n_{P_m}$ – har-bir yo‘l bo‘lagidagi transport vositalari miqdori
1	I.Karimov-Jayhun-Beyneu-Guzar avtotrassasi kesishmasi	6	4, 6, 5, 14, 8, 16
2	I.Karimov-Nasaf Xonobod ko‘chalari kesishmasi	13	10, 10, 6, 7, 8, 7, 11, 10, 7, 8, 11, 12, 6
3	I.Karimov-A.Timur ko‘chalari kesishmasi	12	8, 9, 8, 12, 10, 11, 10, 12, 11, 6, 7, 7
4	I.Karimov-Bunyodkor ko‘chalari kesishmasi	9	15, 15, 9, 7, 14, 8, 10, 13, 10
5	I.Karimov-Mustaqilliq ko‘chalari kesishmasi	14	15, 13, 15, 14, 10, 11, 14, 11, 13, 12, 13, 14, 14, 15
6	I.Karimov-Xonobod ko‘chalari kesishmasi	11	3, 10, 5, 8, 14, 6, 7, 4, 8, 10, 6
7	I.Karimov-Nasaf ko‘chalari kesishmasi	15	4, 5, 7, 3, 13, 12, 14, 4, 4, 5, 6, 4, 4, 4, 5
8	I.Karimov-Mashab ko‘chalari kesishmasi	7	0, 0, 0, 0, 0, 0, 0
9	Nasaf-Kamandi ko‘chalari kesishmasi	8	10, 10, 11, 4, 4, 6, 6, 4
10	Nasaf-A.Timur ko‘chalari kesishmasi	8	1, 2, 4, 10, 3, 4, 7, 4
11	Nasaf-Bunyodkor ko‘chalari kesishmasi	14	4, 2, 1, 3, 5, 6, 4, 3, 4, 4, 6, 5, 5, 4
12	Nasaf-Mustaqilliq ko‘chalari kesishmasi	19	4, 7, 8, 10, 12, 10, 12, 10, 12, 5, 5, 8, 8, 8, 3, 3, 7, 4, 5
13	Nasaf-G‘uzor ko‘chalari kesishmasi	5	6, 3, 3, 8, 7
14	Nasaf-A.Navoiy ko‘chalari kesishmasi	12	3, 2, 1, 1, 4, 2, 1, 3, 3, 2, 1, 1
15	Xonobod-A.Navoiy ko‘chalari kesishmasi	12	0, 3, 1, 3, 7, 2, 5, 5, 3, 4, 7, 6
16	Mustaqilliq-A.Navoiy ko‘chalari kesishmasi	16	4, 8, 7, 3, 2, 9, 10, 12, 7, 7, 8, 4, 5, 7, 6, 7,
17	Olimlar-A.Navoiy ko‘chalari kesishmasi	7	9, 8, 5, 5, 8, 7, 7
18	Mashab-G‘uzor ko‘chalari kesishmasi	6	6, 2, 3, 4, 4, 5
19	Jayhun-Nasaf-A.Timur ko‘chalari kesishmasi	13	7, 10, 14, 8, 13, 13, 11, 15, 13, 5, 7, 6, 7
20	Jayhun-Olimlar ko‘chalari kesishmasi	8	9, 8, 2, 5, 7, 9, 10, 6
21	Jayhun-Mustaqilliq ko‘chalari kesishmasi	9	9, 10, 7, 4, 6, 4, 7, 8, 2

22	Jayhun-Nasaf ko‘chalari kesishmasi	6	4, 2, 4, 8, 8, 3
23	Jayhun-Xonobod ko‘chalari kesishmasi	9	4, 7, 7, 8, 6, 9, 5, 8, 3

Ob’yekt sifatida tanlab olingan chorrahalarning xaritadagi manzillari belgilandi (2-rasm).

2-rasm. Qarshi shahar magistral ko‘chalaridagi chorrahalar

Shuningdek tadqiqotning ob’yektlaridan biri sifatida mexanik transmissiyali transport vositalari ham kiritildi. Ushbu transport vositalari haydovchilarining o‘rtacha reaksiya vaqti t_r – 2 soniyani tashkil etadi [3].

3. Tadqiqot natijalari

Tadqiqot davomida to‘plangan ma’lumotlar mexanik transmissiyali avtotransport vositalarining chorrahalarda qo‘zg‘alishdagi kechikish vaqti sezilarli darajada yuqori ekanligini ko‘rsatdi. Quyidagi natijalar qayd etildi:

Birinchi bo‘lib yuqorida keltirilgan (1)-formula orqali bir yo‘l bo‘lagidagi mos ketma-ketlikda turgan mexanik trasmissiyali transport vositalarining kechikish vaqtlari hisoblandi (2-jadval).

2-jadval

Bir yo‘l bo‘lagidagi mos ketma-ketlikda turgan mexanik transmissiyali transport vositalarining kechikish vaqtlari

T/r	n – bir yo‘l bo‘lagida mos ketma-ketlikda turgan mexanik trasmissiyali transport vositasi	T_n – bir yo‘l bo‘lagida mos ketma-ketlikda turgan mexanik trasmissiyali transport vositasining kechikish vaqti (soniya)
1	1	0
2	2	2
3	3	4
4	4	6
5	5	8
6	6	10
7	7	12
8	8	14
9	9	16
10	10	18
11	11	20
12	12	22
13	13	24
14	14	26
15	15	28
16	16	30
17	17	32
18	18	34
19	19	36
20	20	38

Yuqorida keltirilgan jadvaldagi qiymatlardan bir yo‘l bo‘lagida turgan mexanik transmissiyali transport vositalarining umumiy kechikish vaqtini hisoblashda foydalanildi (2).

3-jadval

Bir yo‘l bo‘lagida turgan mexanik transmissiyali transport vositalarining umumiy kechikish vaqti

T/r	P_m – bir yo‘l bo‘lagida mos ketma-ketlikda turgan mexanik trasmissiyali transport vositalari miqdori	T_P – bir yo‘l bo‘lagida turgan mexanik trasmissiyali transport vositalarining umumiy kechikish vaqti (soniya)
1	1	0
2	2	4
3	3	12
4	4	24
5	5	40
6	6	60
7	7	84
8	8	112
9	9	144
10	10	180
11	11	220
12	12	264
13	13	312
14	14	364
15	15	420
16	16	480
17	17	544
18	18	612
19	19	684
20	20	760

Tadqiqot ob’yekti bo‘lgan 23 ta chorrahalar uchun alohida svetoforning bir sikli davomidagi vaqt ichida yig‘ilib qolgan mexanik transmissiyali transport vositalarining umumiy kechikish vaqtlari hisoblandi. Bunda bitta chorrahaga tegishli har-bir yo‘l bo‘laklaridagi mexanik transmissiyali transport vositalarining umumiy kechikish vaqtlari yig‘indisi hisoblandi (3).

4-jadval

Har-bir chorraha uchun hisoblangan mexanik transmissiyali transport vositalarining umumiy kechikish vaqtlari

T/r	Chorraha nomi	m – yo‘l bo‘laklari soni	W – bitta chorrahaning bir svetofor sikli davomida transport oqimining umumiy

			kechikish vaqti (daqiqa)
1	I.Karimov-Jayhun-Beyneu-Guzar avtotrassasi kesishmasi	6	18
2	I.Karimov-Nasaf Xonobod ko‘chalari kesishmasi	13	30,67
3	I.Karimov-A.Timur ko‘chalari kesishmasi	12	32,07
4	I.Karimov-Bunyodkor ko‘chalari kesishmasi	9	36,93
5	I.Karimov-Mustaqilliq ko‘chalari kesishmasi	14	75,60
6	I.Karimov-Xonobod ko‘chalari kesishmasi	11	20,47
7	I.Karimov-Nasaf ko‘chalari kesishmasi	15	22,67
8	I.Karimov-Mashab ko‘chalari kesishmasi	7	0
9	Nasaf-Kamandi ko‘chalari kesishmasi	8	12,87
10	Nasaf-A.Timur ko‘chalari kesishmasi	8	5,87
11	Nasaf-Bunyodkor ko‘chalari kesishmasi	14	6,47
12	Nasaf-Mustaqilliq ko‘chalari kesishmasi	19	35,67
13	Nasaf-G‘uzor ko‘chalari kesishmasi	5	4,67
14	Nasaf-A.Navoiy ko‘chalari kesishmasi	12	1,20
15	Xonobod-A.Navoiy ko‘chalari kesishmasi	12	6,20
16	Mustaqilliq-A.Navoiy ko‘chalari kesishmasi	16	23,27
17	Olimlar-A.Navoiy ko‘chalari kesishmasi	7	10,27
18	Mashab-G‘uzor ko‘chalari kesishmasi	6	2,73
19	Jayhun-Nasaf-A.Timur ko‘chalari kesishmasi	13	43,07
20	Jayhun-Olimlar ko‘chalari kesishmasi	8	12,80
21	Jayhun-Mustaqilliq ko‘chalari kesishmasi	9	11,93
22	Jayhun-Nasaf ko‘chalari kesishmasi	6	4,80
23	Jayhun-Xonobod ko‘chalari kesishmasi	9	11,20

Olingan natijalar mexanik transmissiyali avtotransport vositalarining chorrahalardagi harakat samaradorligiga bo‘lgan ta'sirini aniq ko‘rsatdi. Yo‘l bo‘laklari soni va transport oqimi o‘rtasidagi muvozanatsizliklar kechikish vaqtini sezilarli darajada oshirdi. Bu natijalar shahar transport infratuzilmasini takomillashtirish va harakat oqimini optimallashtirish bo‘yicha chora-tadbirlarni ishlab chiqishda muhim ahamiyat kasb etadi. Mexanik transmissiyali avtomobillarning kechikish vaqti ko‘paytirilishi transport harakatidagi nazoratini qiyinlashtiradi va umumiy o‘tkazuvchanlikni pasaytirishi mumkinligini ko‘rsatdi.

Tadqiqotda qo‘llanilgan metodologiya va o‘lchov usullari natijalarning haqqoniyligini ta'minladi. Eksperimental usullar orqali yig‘ilgan ma'lumotlar aniq va ob’yektiv bo‘lib, ular transport oqimi va kechikish vaqti o‘rtasidagi bog‘liqlikni to‘g‘ri aks ettirdi. Statistik tahlil natijalarning ahamiyatliligini tasdiqladi, bu esa xulosalarning ishonchliligini oshirdi.

Bunday tadqiqotlardagi asosiy chegaralardan biri ma’lumotlarni yig‘ish jarayonidagi ehtimoliy xatolar va tanlovning cheklanganligi bo‘lishi mumkin. Masalan, jadvaldagi ba'zi chorrahalarda kechikish vaqti nol ko‘rsatilgan, bu ma’lumotlarning noaniqligi yoki o‘lchovdagi xato natijasi bo‘lishi mumkin. Shuning uchun, kelgusi tadqiqotlarda ma’lumotlarning aniqligini oshirish va imkoniyat boricha kengroq chorrahalarni qamrab olish tavsiya etiladi.

4. Tadqiqot natijalari tahlili

Tadqiqot davomida olingan natijalardan kelib chiqib, mexanik transmissiyali avtotransport vositalarining chorrahalar o‘tkazuvchanligiga ta’siri aniq ko‘rsatildi. Masalan, tadqiqotdan ayon bo‘ldiki, mexanik transmissiyali

avtotransport vositalardagi kechikish vaqti, ayniqsa, ko‘p yo‘l bo‘laklariga ega chorrahalarda sezilarli darajada uzoq bo‘ladi. Bu holat transport oqimining sustlashishiga va yo‘l o‘tkazuvchanligining pasayishiga olib keladi. Birgina I.Karimov-Mustaqilliq ko‘chalari kesishmasida jami 14 ta yo‘l bo‘lagi bo‘lsa svetoforning bir siklida yig‘ilgan 184 ta transport vositalari har birining kechikish vaqtlari yig‘indisi 1 soatu 15 daqiqadan ko‘proq vaqtni tashkil etdi. Transport oqimini yaxshilash uchun mexanik transmissiyali avtotransport vositalarining ishtiroki kamaytirilishi zarur.

Tadqiqot natijalari orqali muammoning iqtisodiy zarari ham hisoblandi. Tanlab olingan 23 ta chorrahada bir svetofor sikli davomida jami 1627 ta transport vositasining har birining kechikish vaqtlari yig‘indisi 429 daqiqa (7.15 soat)ni tashkil etdi. Quyidagi 5-jadvalda kechikish vaqti natijasida yoqilg‘i isrofi miqdorining iqtisodiy zarari keltirilgan.

5-jadval

Kechikish vaqtining yoqilg‘i isrofi natijasida keltirgan iqtisodiy zarari

T/r	Yoqilig‘i turi	Yoqilg‘i narxi (so‘m/litr)	Yoqilg‘i isrofi (litr)	O‘rtacha iqtisodiy zarar (so‘m)
1	Metan	3,500 - 4,000 сўм/м³	19,3	72 375
2	Propan	5,500 - 6,500	15	90 000
3	Ai-80 benzini	6,500 - 7,500	17,16	120 120
4	Ai-91 benzini	10,500 - 12,000	17,16	193 050
5	Ai-95 benzini	13,500 - 15,000	21,45	305 662
6	Dizel yoqilg‘isi	12,000 - 14,000	17,16	223 080

Yuqoridagi iqtisodiy zarar faqatgina svetoforning bir sikli davomida hosil bo‘lgan. Endi bu qiymatlarni bir soat, kun, hafta va oylar kesimida hisoblab chiqadigan bo‘lsak qanchalik ulkan summa kelib chiqishini tasavvur qilish qiyin emas. Undan tashqari yoqilg‘i isrofi tufayli atmosferaga chiqayotgan zaxarli gazlarni ham ekologiyaga zarar etkazishini, ayniqsa birgina Toshkent shahrining havo iflosligi bo‘yicha dunyo shaharlari reytingida yuqoriligini aytib o‘tish lozim.

5. Xulosa

Mazkur tadqiqot shahar magistral ko‘chalarida mexanik transmissiyali avtotransport vositalarining chorrahalar o‘tkazuvchanligiga ta’sirini o‘rganishga qaratildi va bu boradagi ilmiy ishlar uchun muhim asos bo‘lib xizmat qiladi. Olingan natijalar shaharlardagi transport oqimi samaradorligini oshirishdagi muhim muammolarni hal etishga yordam berishi mumkin. Xususan, mexanik transmissiyali transport vositalarining kechikish vaqti va ularning yoqilg‘i isrofiga ta'siri aniqlanib, bu jarayonning iqtisodiy zarari baholandi. Tadqiqotda aniqlangan muammolar, xususan, chorrahalarda transport vositalarining kechikish vaqti, ularning transport oqimiga salbiy ta’sir ko‘rsatishi va bu holat shaharlarda yo‘l o‘tkazuvchanligini sezilarli darajada pasaytirishi mumkinligi ko‘rsatib o‘tildi. Bu muammolarni hal etish, shahar transport tizimini yanada takomillashtirish uchun amaliy tavsiyalar ishlab chiqishga imkon beradi. Shuningdek, tadqiqot natijalari, transport muhandisligi va yo‘l harakatini boshqarish sohalarida amaliy qo‘llanilishi mumkin. Mazkur izlanish shahar infratuzilmasini rivojlantirish va transport oqimini samarali boshqarishga qo‘shadigan hissasi bilan ahamiyatlidir. Natijalar asosida amalga oshirilgan tavsiyalar transport vositalarining kechikish vaqti va yoqilg‘i isrofini kamaytirishga, shuningdek, yo‘l o‘tkazuvchanligini oshirishga xizmat qilishi mumkin.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Choriyev Jahongir Abdimo‘min o‘g‘li	Toshkent davlat transport universiteti “Transport intellektual tizimlari muhandisligi” kafedrasi tayanch doktoranti. E-mail: jahongirc9@gmail.com Tel.:+998942949402 https://orcid.org/0009-0009-9975-7444
Fayzullayev Erkin Zikrullayevich	Toshkent davlat transport universiteti “Transport vositalari muhandisligi” kafedrasi t.f.n., v.b. professor E-mail: erkin.fayzullayev@gmail.com Tel.:+998909567585 https://orcid.org/0009-0007-6294-9392

Analysis of economic indicators of tashkent metropolitan

S.T. Norkulov[1][a]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: After gaining independence, Uzbekistan chose a unique and suitable path of development and renewal in the economic, socio-political, ideological and spiritual spheres. Sustainable development of the country's economy, achieving sustainable economic growth rates, ensuring the competitiveness of our national products on the world market, improving the standard of living and well-being of our people are among the most important tasks today.

Keywords: Subway, tunnels, station, complex, metropolitan

Toshkent metropoliteni iqtisodiy ko‘rsatkichlar tahlili

Norkulov S.T.[1][a]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: O‘zbekiston mustaqillikka erishganidan so‘ng iqtisodiy, ijtimoiy-siyosiy, mafkuraviy-ma’naviy sohalarda taraqqiyot va yangilanishning o‘ziga xos hamda o‘ziga mos yo‘lni tanladi. Mamlakat iqtisodiyotini barqaror rivojlantirish, barqaror iqtisodiy o‘sish sur’atlariga erishish, jahon bozorida milliy mahsulotlarimizning raqobatbardoshligini ta’minlash, xalqimizning hayot darajasi va farovonligini oshirish bugungi kundagi eng ustuvor vazifalardan hisoblanadi.

Kalit so‘zlar: Metro, tonnellar, bekat, majmua, metropoliten

1. Kirish

“Toshkent metropoliteni” DUK mahalliylashtirishni moliyalashtirish bo‘yicha huquqiy asoslariga e’tibor beradigan bo‘lsak, cheklangan tariflar bo‘yicha ko‘rilgan zararlarni qoplash, xizmat muddati tugagan metro vagonlarini modernizatsiya qilish orqali xizmat muddatini 15 yilga uzaytirish bo‘yicha budjet mablag‘lari hisobidan moliyalashtirish hamda metropolitenda yangi yo‘nalish va bekatlarini qurilishini Respublika va boshqa mablag‘lar hisobidan moliyalashni ko‘rishimiz mumkin.

“Toshkent metropoliteni” DUK mahalliylashtirishni moliyalashtirish bo‘yicha huquqiy asosi sifatida cheklangan tariflar bo‘yicha ko‘rilgan zararlarni qoplash O‘zbekiston Respublikasining 1997 yil 25 aprelda qabul qilingan “Shahar yo‘lovchilar transporti to‘g‘risida”gi 419-I-sonli Qonuni:

12-modda. Yo‘l qo‘yiladigan doiradagi tariflarni belgilash va ularga rioya etilishi ustidan nazoratni uyushtirish mahalliy davlat hokimiyati organlarining vakolatlari doirasida belgilanadi;

15-modda. Shahar yo‘lovchilar transporti tashuvchilarining yo‘l qo‘yiladigan doiradagi tariflar bo‘yicha yo‘lovchilar va bagaj tashish xizmatlari ko‘rsatish munosabati bilan ko‘rgan zarari Vazirlar Mahkamasi tomonidan belgilangan tartibda tegishli mahalliy budjet hisobidan qoplanishi, shuningdek shaharda yo‘lovchilar tashish sohasidagi ilmiy-tadqiqot ishlari, metropoliten qurilishi, qoida tariqasida, davlat budjeti hisobidan amalga oshiriladi belgilangan.

O‘zbekiston Respublikasi Vazirlar Mahkamasining “Umumiy foydalaniladigan transportda yo‘lovchi tashuvchilar faoliyatini hamda ularni moliyalashtirish tartibini takomillashtirish to‘g‘risida” 2012 yil 17 sentyabrdagi 273-sonli qarori bilan “O‘zbekiston Respublikasida yo‘lovchilar aylanmasini va umumiy foydalaniladigan avtomobil va elektr transportida shaharda, shahar atrofida, shaharlararo, xalqaro yo‘nalishlarda hamda soatlar bo‘yicha tashilgan yo‘lovchilar sonini aniqlash tartibi to‘g‘risida nizomi tasdiqlangan bo‘lib, unga ko‘ra quyidagilar O‘zbekiston Respublikasi Davlat budjeti mablag‘lari hisobiga moliyalashtirilishi belgilangan:

fuqarolarning ayrim toifalarining transportda bepul va imtiyozli yurishi bilan bog‘liq holda tashuvchilarning olinmay qoladigan daromadlarini subsidiyalar berish orqali qoplash;

cheklangan tariflar bo‘yicha yo‘lovchilar va bagajni tashish bo‘yicha xizmatlar ko‘rsatilishi munosabati bilan shahar yo‘lovchi tashish transporti tashuvchilari ko‘radigan zararlarni qoplash;

Toshkent metropolitenida kunduzi soat 10:00 dan 16:00 gacha bo‘lgan kunduzgi davrda pensionerlarni bepul tashishda olinmay qoladigan daromadlarni qoplash.

Nizomga muvofiq Toshkent metropolitenida bepul yuruvchi va imtiyozli yo‘lovchilarni tashishi munosabati bilan olinmay qoladigan daromadlarini, shuningdek cheklangan tariflar bo‘yicha xizmatlar ko‘rsatishdan ko‘riladigan

zararlarini subsidiyalar berish orqali qoplash har oyda, O‘zbekiston Respublikasi Davlat budjetining tasdiqlangan parametrlari doirasida amalga oshiriladi.

Tashuvchilarning olinmay qoladigan daromadlarini qoplashga mablag‘lar ajratish uchun quyidagilar asos hisoblanadi:

[a] https://orcid.org/0000-0001-8047-0835

shahar yo‘lovchilar transportidan bepul foydalanish huquqiga ega bo‘lgan shaxslarni har yili xatlovdan o‘tkazish natijalari - shahar yo‘lovchilar transportidan bepul foydalanish huquqiga ega bo‘lgan yo‘lovchilarni tashishda, har oyda teng ulushlar bilan moliyalashtirgan holda;

shahar yo‘lovchi transportini boshqarish organining oylik transportda yurish imtiyozli kartochkalarining amalda sotilishi to‘g‘risidagi axboroti - transportda imtiyozli yurish huquqiga ega bo‘lgan yo‘lovchilarni tashishda.

2. Tadqiqot metodologiyasi

Choraklik moliya hisobotini topshirgandan keyin dastlabki o‘n kun mobaynida tashuvchi mahalliy davlat hokimiyati tegishli organi bilan oldingi chorakdagi ish yakunlari bo‘yicha qoplanishi kerak bo‘lgan amalda ko‘rilgan zararlar hajmini kelishadi, bunda liniyadagi tushumning to‘liq yig‘ilishini ta’minlash, shuningdek ko‘rsatiladigan xizmatlar tannarxini pasaytirish bo‘yicha qabul qilingan tadbirlar hisobga olinadi.

Tashuvchilar ko‘rgan zararlarni qoplash uchun zarur bo‘lgan mablag‘lar summasi tushumning to‘liq yig‘ilishi bo‘yicha chora-tadbirlarni hisobga olgan holda, amaldagi daromadlar, shuningdek fuqarolar ayrim toifalarining transportda bepul va imtiyozli yurishi bilan bog‘liq holda olinmay qoladigan daromadlarni qoplash summasi bilan amaldagi xarajatlar o‘rtasidagi tafovut tarzida aniqlanadi, bunda ko‘rsatiladigan xizmatlar tannarxini pasaytirish tadbirlari hisobga olinadi.

Bunda ko‘rilgan zararlarni qoplash summasi qonun hujjatlariga muvofiq shahar yo‘lovchi tashish transportida bepul va imtiyozli yurish huquqiga ega bo‘lgan fuqarolarning ayrim toifalari uchun chegirishlar va imtiyozlarni hisobga olgan holda aniqlanadi.

Ushbu miqdorlar o‘rtasidagi tafovut nol yoki ijobiy (tashkilotlarning foydasi) bo‘lgan taqdirda ko‘rilgan zararlar qoplanmaydi.

Tashuvchilar ko‘rgan zararlarni qoplash miqdoriga yoqilg‘i-moylash materiallari, elektr energiyasi, asosiy ehtiyot qismlar va materiallar narxlari o‘zgarganda hamda cheklangan tariflarni shakllantirishda nazarda tutilmagan eng kam oylik ish haqining miqdori o‘zgarganda, shuningdek liniyadagi tushumning to‘liq yig‘ilishini ta’minlash, shuningdek ko‘rsatiladigan xizmatlar tannarxini pasaytirish tadbirlari hisobga olingan holda tuzatishlar kiritiladi.

Vazirlar Mahkamasining «Umumiy foydalaniladigan transportda yo‘lovchi tashishda yo‘lkira haqini to‘lashning avtomatlashtirilgan tizimini joriy etish to‘g‘risida» 2019 yil 25 noyabrdagi 948-son qaroriga muvofiq, Vazirlar Mahkamasining «Umumiy foydalaniladigan transportda yo‘lovchi tashuvchilar faoliyatini hamda ularni moliyalashtirish tartibini takomillashtirish to‘g‘risida» 2012 yil 17 sentyabrdagi 273-son qaroriga o‘zgartirish va qo‘shimchalar kiritildi.

Unga ko‘ra quyidagi qo‘shimcha va o‘zgartirishlar kiritildi:

Mahalliy ijro etuvchi hokimiyat organlariga O‘zbekiston Respublikasi Transport vazirligi va Moliya vazirligi bilan kelishilgan holda shaharda yo‘lovchilarni muntazam tashish transportining tarif rejalari tarkibiga o‘zgartirish va qo‘shimchalar kiritish huquqi berildi;

Umumiy foydalaniladigan transport — yo‘lovchilar va yuk tashish uchun mo‘ljallangan jamoat yer usti va yer osti transporti (avtobus, elektrobus, trolleybus, tramvay, yo‘nalishli va yo‘nalishsiz taksilar, metropoliten);

oylik transportda yurish kartochkasi — harakatlanish hududi chegaralarida va ushbu hujjat amal qiladigan davr mobaynida barcha yo‘nalishlar bo‘yicha umumiy foydalaniladigan transportda (avtobus, elektrobus, trolleybus, tramvay va metropolitenda) yurish imkoniyatini olishga yo‘lovchining huquqini tasdiqlaydigan, qat’iy hisobda turadigan hujjat. Oylik yurish kartochkasi ikki turga — umumiy va imtiyozli kartochkaga bo‘linadi:

umumiy oylik transportda yurish kartochkasi — yo‘nalishli va yo‘nalishsiz taksilardan tashqari, umumiy foydalaniladigan transportning barcha turlarida yo‘lovchilar yurishini nazarda tutadigan, qat’iy hisobda turadigan hujjat»;

quyidagi mazmundagi o‘n beshinchi va o‘n oltinchi xatboshilar qo‘shilsin:

transport kartasi — yo‘lovchilar tomonidan umumiy foydalaniladigan transportda (yo‘nalishsiz taksidan tashqari) yurganlik uchun amaldagi tarif asosida yo‘l haqini to‘liq to‘lash uchun mo‘ljallangan shaxsiylashtirilmagan ko‘p marotabalik debet to‘lov kartasi. Transport kartasining depozit hisob raqami pul mablag‘larini tushirish orqali to‘ldiriladi. Transport kartasidagi tarif rejalarining to‘liq qiymati umumiy foydalaniladigan transportdagi cheklangan tarifni, chegirma va imtiyozlarni hisobga olgan holda, yurishlar soniga ko‘paytirish yo‘li bilan aniqlanadi;

imtiyozli transport kartasi — umumiy foydalaniladigan transportda (yo‘nalishli va yo‘nalishsiz taksidan tashqari) avtomatlashtirilgan to‘lov tizimi operatori ma’lumotlar bazasida ro‘yxatga olingan yo‘lovchiga transportda bepul yoki imtiyozli yurish huquqini kafolatlaydigan, transportdan foydalanish soni va bir transportdan boshqasiga chiqish soni cheklanmaydigan shaxsiylashtirilmagan va(yoki) shaxsiylashtirilgan transport kartasi»;

Imtiyozli yurish huquqiga ega bo‘lgan yo‘lovchilar (pensionerlar, nogironligi bo‘lgan shaxslar, talabalar va umumiy o‘rta ta’lim muassasalari, akademik litseylar, kasb-hunar maktablari, kollejlar hamda texnikumlar o‘quvchilari) tomonidan imtiyozli transport kartalari orqali to‘lovlar umumiy foydalaniladigan transportning (yo‘nalishli va yo‘nalishsiz taksidan tashqari) amaldagi tariflarning 50 foizlik imtiyozini hisobga olgan holda amalga oshiriladi;

fuqarolarning ayrim toifalarining transportda bepul va imtiyozli yurishi bilan bog‘liq holda tashuvchilarning olinmay qoladigan daromadlarini subsidiyalar berish orqali qoplash;

xarajatlarni moliyalashtirish, joriy oyning 5-sanasigacha, avans to‘lovlarini teng holda tasdiqlangan budjet parametrlari bo‘yicha amalga oshiriladi. Chorak yakunlariga ko‘ra, oldindan qilingan to‘lovlar va ko‘rilgan zarar hajmlari keyingi davr to‘lovlariga tegishli o‘zgartirishlar kiritilishini inobatga olgan holda solishtiriladi;

Navbatdagi moliya yili uchun ushbu Nizomning 4-bandida nazarda tutilgan maqsadlarga mablag‘larning aniq summasi asoslangan hisob-kitoblarga muvofiq aniqlanadi hamda O‘zbekiston Respublikasi Davlat budjetining tasdiqlangan parametrlari doirasida yoki O‘zbekiston Respublikasi Vazirlar Mahkamasining alohida qarorlari asosida ajratiladi;

Fuqarolarning ayrim toifalarining transportda bepul va imtiyozli yurishi bilan bog‘liq holda tashuvchilarning olinmay qoladigan daromadlarini subsidiyalar berish orqali

qoplash har oyda, O‘zbekiston Respublikasi Davlat budjetining tasdiqlangan parametrlari doirasida amalga oshiriladi;

Joriy oyning 5-sanasiga qadar tegishli mahalliy davlat hokimiyati organi tomonidan mahalliy budjet parametrlariga kiritilgan tashuvchilarning prognozlashtirilgan zarar ko‘rsatkichlariga muvofiq avans to‘lovlari amalga oshiriladi. Chorak yakunlariga ko‘ra hisobot davri uchun yuzaga kelgan avans to‘lovlari bilan tashuvchilarning amaldagi ko‘rgan zararlari miqdoridagi farqiga, navbatdagi avans to‘lovlarini amalga oshirishda tuzatishlar kiritiladi.

“Toshkent metropoliteni” DUK mahalliylashtirishni moliyalashtirish bo‘yicha huquqiy asosi sifatida xizmat muddati tugagan metro vagonlarini modernizatsiya qilish orqali xizmat muddatini 15 yilga uzaytirish bo‘yicha budjet mablag‘lari hisobidan moliyalashtirish

Vazirlar Mahkamasining 2014 yil 17 mart 170-sonli farmoyishiga asosan 6 ta harakat tarkibini modernizatsiya qilish bo‘yicha 2 973,0 ming.AQSH dollari hamda Vazirlar Mahkamasining 2015 yil 30 martdagi 190-sonli farmoyishiga asosan 6 ta harakat tarkibini modernizatsiya qilish bo‘yicha 5 500 ming AQSH dollari miqdorida mablag‘ ajratilgan.

O‘zbekiston Respublikasi Vazirlar Mahkamasining 2016 yil

3 fevraldagi “2016 - 2019 yillar davrida "Toshkent metropoliteni" DUK poyezdlarining harakat xavfsizligini ta’minlash maqsadida, moddiy-texnik bazani mustahkamlash, harakatdagi tarkibni zamonaviylashtirish va zamonaviy muhandislik-texnik vositalar bilan jihozlash chora-tadbirlari kompleksi to‘g‘risida”gi 24-sonli qaroriga asosan “Toshkent metropoliteni” davlat unitar korxonasida xizmat muddati tugagan 96 ta vagonlarni davlat budjeti hisobidan ta’mirlash va modernizatsiya qilish orqali metro vagonlarining xizmat muddatini 15 yilga uzaytirish bo‘yicha 50 400 ming. AQSH dollari miqdorida mablag‘ ajratilgan (1-jadval).

1-jadval

Metro vagonlarni modernizatsiya qilish bo‘yicha mahalliylashtirishni moliyalashtirishning huquqiy asosi

№	Qarorlar	Vagonlar soni	Ajratilgan mablag‘	O‘zlashtirilgan mablag‘	
				ming.doll	mln.so‘m
1.	VMQ-170-f (17.03.2014 y.)	6	2 973,0	2 973,0	6 710,7
2.	VMQ-190-f (30.03.2015 y.)	10	5 500,0	5 500,0	13 696,1
3.	VMQ-24 (03.02.2016 y.)	96	50 400,0	30 740,6	170 201,9

Respublikada ijtimoiy va ishlab chiqarish infratuzilmasini jadal rivojlantirish, tadbirkorlik subyektlariga qulay investitsiya muhitini yaratish, iqtisodiyot tarmoqlari va ijtimoiy sohani qo‘llab-quvvatlash, shuningdek, davlat-xususiy sheriklik asosida yangi infratuzilma obyektlarini barpo etish; shu asosda aholi bandligini ta’minlash va ularning turmush darajasini yanada yaxshilash maqsadida O‘zbekiston Respublikasi Prezidentining “2021-2023 yillarda O‘zbekiston Respublikasining ijtimoiy va ishlab chiqarish infratuzilmasini rivojlantirish chora-tadbirlari to‘g‘risida” 2020 yil 28 dekabrdagi

PQ-4936-son qaroriga asosan 28 ta metro vagonlarini modernizatsiya qilish orqali metro vagonlarining xizmat muddatini 15 yilga uzaytirish bo‘yicha 92 000 mln.so‘m miqdorida mablag‘ ajratilgan.

Mamlakatimizning ijtimoiy va ishlab chiqarish infratuzilmasini izchil rivojlantirish, qishloq va mahallalarni yanada obod qilish, joylarda qulay tadbirkorlik va investitsiya muhitini shakllantirish, shuningdek, iqtisodiyot tarmoqlari va ijtimoiy sohaga investitsiyalarni keng jalb qilish orqali yangi ish o‘rinlarini yaratish, aholining turmush darajasini yaxshilash va kambag‘allikni qisqartirish maqsadida O‘zbekiston Respublikasi Prezidentining “2022 — 2024 yillarda O‘zbekiston Respublikasining ijtimoiy va ishlab chiqarish infratuzilmasini rivojlantirish chora-tadbirlari to‘g‘risida” 2022 yil 22 yanvardagi PQ-98-son qaroriga asosan 16 ta metro vagonlarini modernizatsiya qilish orqali metro vagonlarining xizmat muddatini 15 yilga uzaytirish bo‘yicha 44 700,0 mln.so‘m hamda yangi metro vagonlarini ishlab chiqarish uchun 80 000,0 mln.so‘m jami 124 700,0 mln.so‘m miqdorida mablag‘ ajratilgan (2-jadval).

2-jadval

Metro vagonlarni modernizatsiya qilish bo‘yicha mahalliylashtirishni moliyalashtirishning huquqiy asosi, mln.so‘m

№	Qarorlar	Vagonlar soni	Ajratilgan mablag‘	O‘zlashtirish	
				yil	mln.so‘m
1.	PQ-4936 (28.12.2020 y.)	28	92 000,0	2021	92 000,0
2.	PQ-98 (22.01.2022 y.)	8	44 700,0	2022	44 700,0
		20	80 000,0		80 000,0

“Toshkent metropoliteni” DUK mahalliylashtirishni moliyalashtirish bo‘yicha huquqiy asosi sifatida metropolitenda yangi yo‘nalish va bekatlarini qurilishini Respublika va boshqa mablag‘lar hisobidan moliyalashni Toshkent shahrining transport infratuzilmasini yanada takomillashtirish, yo‘lovchilar oqimini ko‘paytirish, Toshkent metropolitenining Yunusobod liniyasida yo‘lovchilar tashish darajasi va sifatini oshirish, shahar yer usti jamoat transportiga yuklamalarni kamaytirish, shuningdek, ekologiya va atrof muhit muhofazasini yaxshilash maqsadida O‘zbekiston Respublikasi Prezidentining «Toshkent metropoliteni Yunusobod liniyasi ikkinchi bosqichini qurish» loyihasini amalga oshirishga doir chora-tadbirlar to‘g‘risida” 2016 yil 7 noyabrdagi PQ-2653-sonli qaroriga asosan Quyidagilar hisoblab chiqilgan qiymati ekvivalentda 124,8 mln AQSH dollari bo‘lgan

loyihani amalga oshirishni moliyalashtirish manbalari etib belgilangan.

3. Xulosa

Davlat budjeti mablag‘lari hisobiga O‘zbekiston Respublikasi Investitsiya dasturi parametrlarida 2017 — 2019 yillar davomida har yili teng ulushlarda nazarda tutiladigan 72,0 mln. AQSH dollari ekvivalentidagi markazlashtirilgan investitsiyalar;

import asbob-uskunalari, materiallar va butlovchi buyumlarni xarid qilish, jalb etiladigan xorijiy mutaxassislarning loyiha hujjatlari ekspertizasini o‘tkazish, qurilishni kuzatib borish va texnik jihatdan nazorat qilish, zarur hollarda xorijiy pudrat tashkilotlari tomonidan amalga oshiriladigan maxsus qurilish-montaj ishlarini bajarish bo‘yicha xizmatlarga haq to‘lash, shu jumladan loyihani amalga oshirish doirasidagi ularning boshqa valyuta xarajatlarini, shuningdek, qurilish-pudrat tashkilotlarini jihozlash uchun texnika xarid qilishni moliyalashtirish uchun 15 yil muddatga, shu jumladan 4 yillik imtiyozli davr bilan, jumladan qayta moliyalashtiruvchi bankning marjasi 0,25 foiz bo‘lgan yillik 2,25 foiz stavkasida taqdim etiladigan, O‘zbekiston Respublikasi Tashqi iqtisodiy faoliyat milliy banki tomonidan qayta moliyalashtiriladigan O‘zbekiston Respublikasi Tiklanish va taraqqiyot jamg‘armasining 52,8 mln. AQSH dollari miqdoridagi krediti hisobidan moliyalashtirilgan.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Norkulov Suxrob Turakulovich	"Toshkent Metropoliteni " DUK boshlig'ining ilmiy-innovatsion rivojlantirish masalalari bo'yicha o'rinbosari - Toshkent davlat transport universiteti prorektori E-mail: sni.kor@bk.ru https://orcid.org/0000-0001-8047-0835

Structure production of cement concrete based on secondary fillers from concrete slaves

S.S. Salikhanov [1][a] , T.O. Kenjayev[1][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: The method of creating a structure of cement concrete based on secondary fillers obtained from concrete scrap is an effective method used in the field of bridge constructions, which allows finding complex solutions in construction.

Keywords: crushed reinforced concrete, modifiers, secondary fine and secondary large aggregate., ordinary fine aggregate + secondary large aggregate; type 2 - ordinary and secondary fine aggregate + secondary large aggregate

Beton lomidan olingan ikkilamchi to‘ldiruvchilar asosidagi sementli betonning struktura hosil qilish

Salixanov S.S.[1][a], Kenjayev T.O.[1][b]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Beton lomidan olingan ikkilamchi to‘ldiruvchilar asosidagi sementli betonning strukturasini hosil qilish usuli ko‘prikli inshootlar sohasida qo‘llaniladigan samarali usul bo‘lib, qurilishda murakkab yechimlarni topish imkonini beradi.

Kalit so‘zlar: yanchilgan temir beton , modinfikatorlar, ikkilamchi mayda va ikkilamchi yirik to‘ldiruvchi., oddiy mayda to‘ldiruvchi + ikkilamchi yirik to‘ldiruvchi;, 2-toifa - oddiy va ikkilamchi mayda to‘ldiruvchi + ikkilamchi yirik to‘ldiruvchi

1. Kirish

Jahonda resurs- va energiyatejamkor ekologik xavfsiz sementli kompozitsiyalar va texnologiyalarni yaratish va ularni qurilish industriyasida ishlab chiqarishga joriy etish masalalari yetakchi o‘rinni egallamoqda. Qurilish industriyasi sohasida material va energetik resurslarni iqtisod qilishning eng muhim zahirasi temirbeton buyumlari korxonalari va qurilish ob’ektlarining beton lomi ko‘rinishidagi chiqindilaridan unumli foydalanish hisoblanadi. Shuning uchun ko‘pchilik mamlakatlarda nokonditsion temirbeton buyumlarini mexanik usulda yemirish bo‘yicha komplekslarning keng joriy qilinishi va maydalangan betondan ikkilamchi to‘ldiruvchi olinishi tufayli ularni temirbeton buyumlar va konstruksiyalarda ratsional ravishda qo‘llash masalasini yechish dolzarb masala sifatida ko‘rilmoqda. Jahonning yetakchi mamlakatlari, shular jumlasidan AQSh, Yaponiya, Germaniya, Daniya, Belgiya va Niderlandiya ilmiy-tadqiqot markazlarida ikkilamchi to‘ldiruvchilar va ularning asosida olinuvchi betonlarning tarkibini tanlash va xossalarini o‘rganish bo‘yicha keng ko‘lamli tadqiqotlar olib borilmoqda. Bu borada ikkilamchi to‘ldiruvchilar asosidagi sementli betonlarning oddiy va modifikatsiyalangan turlari tarkiblari ishlab chiqilganligi va ularning qurilish-texnik va ekspluatatsion xossalarini yaxshilash maqsadida kimyoviy va mineral qo‘shimchalardan foydalanish, qo‘shimchalarning gidratatsiya vaqtida kristallogidratlarning hosil bo‘lishiga ta’siri qonuniyatlari, qotayotgan sement toshida struktura hosil bo‘lishini maqsadli boshqarish mexanizmlarining ochib berilganligini ta’kidlab o‘tish juda muhim hisoblanadi.

Respublikamizda qurilish materiallari sanoatini rivojlantirish, tabiiy xomashyo materiallarini iqtisod qilish va sanoat chiqindilaridan ishlab chiqarishda foydalanish imkonini beruvchi resurs- va energiya- tejamkor texnologiyalarni joriy etishga alohida e’tibor qaratilmoqda.

2. Tadqiqot metodikasi

Yaponiyada beton lomini qayta ishlash va ikkilamchi to‘ldiruvchlarni qayta ishlatishning eng keng tarqalgan sxemasi yuqorida ko‘rib chiqilgan 3-variantga to‘g‘ri keladi [3]. Beton lominiyangi beton tarkibida ikkilamchi to‘ldiruvchi sifatida ishlatishning samaradorligini oshirish uchun bunday to‘ldiruvchini ishlab chiqarish joyida katta bo‘lmagan burdalagich va groxot yordamida tayyorlash maqsadga muvofiq hisoblanadi. Shu yerning o‘zida undan beton qorishmasini tayyorlashda foydalaniladi va yangi inshootni barpo qilishda konstruksiyaga joylashtiriladi. “Yopiq sistema” bo‘yicha ikkilamchi to‘ldiruvchini ishlab chiqarish texnologiyasi Niderlandiyada keng ko‘lamda qo‘llanilmoqda [4].

[a] https://orcid.org/0000-0001-5322-3150
[b] https://orcid.org/0009-0000-2152-0468

Qurilish chiqindilarini utilizatsiya qilishning mavjud bo‘lgan quyidagi sxemlarini tahlil qilib chiqamiz:

A) bino buziladi, xosil bo‘lgan qattiq qurilish chiqindilari esa ko‘mish uchun maxsus poligonlarga olib borib tashlanadi;

B) bino buziladi, xosil bo‘lgan qattiq qurilish chiqindilarining bir qismi ko‘mish uchun maxsus poligonlarga, ikkinchi qismi esa qayta ishlash uchun mo‘ljallangan statsionar markazlarga olib borib tashlanadi;

V) bino bo‘laklarga ajratib tashlanadi va beton va temirbeton konstruksiyalar qayta ishlash uchun mo‘ljallangan statsionar markazlarga olib borib tashlanadi;

G) bino bo‘laklarga ajratib tashlanadi va isitgich qatlamisiz barcha beton va temirbeton konstruksiyalar qayta ishlash uchun mo‘ljallangan statsionar markazlarga olib borib tashlanadi. Isitgich qatlami mavjud bo‘lgan konstruksiyalar va boshqa chiqindilar ko‘mish uchun mo‘ljallangan maxsus poligonlarga olib borib tashlanadi.

O‘tkazilgan taxlil quyidagi xulosalarga olib keldi:

-qurilish chiqindilarini iqtisodiy jihatdan eng tejamkor utilizatsiya qilish varianti b) varianti hisoblanadi;

-qurilish chiqindilarini ekologik jixatdan xavfsiz utilizatsiya qilish varianti v) varianti hisoblanadi.

Shaharlardagi bir va ikki qavatli binolarni buzish, ko‘prikka oid konstruksiyalar va yo‘l qoplamalarini almashtirishning ortib boruvchi hajmlari tufayli yemiriluvchi inshoot va konstruksiyalar elementlarini ikkilamchi noruda qurilish materiallari olish maqsadida qayta ishlash muammolari tobora dolzarblashib bormoqda.

Ilk bor yemiriluvchi konstruksiyalardan burdalangan material olishni 1946 yilda VNIIG (Rossiya) instituti xodimi muxandis Glujge P.I. tomonidan Dneprostroy uchun taklif qilgan. Urushdan keyingi yillarda to‘ldiruvchilar olish uchun urush vaqtida buzilgan bino va inshootlar elementlaridan foydalanish o‘ta muhim bo‘lgan. 1947- 48 yillarda aynan shunday tadqiqotlarni Ploger R.R. va Graf O. (Germaniya) o‘tkazdilar. Biroq keyinchalik tabiiy noruda qurilish materiallari chiqarish va qurilish ob’ektlariga yetkazib berish yo‘lga qo‘yilganligi sababli beton va temirbeton lomidan olinuvchi ikkilamchi to‘ldirgichlardan foydalanish o‘zining dolzarbligini ancha yo‘qotdi.

Ovropali tadqiqotchilar burdalangan mahsulotlardan foydalanish imkoniyatlarini o‘rganishga 1960-yillarda qaytib qolishdi. Bu ayniqsa mineral xom ashyo zaxiralari cheklangan bo‘lgan, uy-joy fondi yangilanayotgan va hosil bo‘layotgan chiqindilarni ko‘mish uchun bo‘sh yerlar tanqis bo‘lgan mamlakatlarda keng yo‘lga qo‘yildi.

MDH mamlakalarida yuqorida keltirilgan muammolarni o‘rganishga 1980-yillarda qaytib kelishdi. Bu vaqtga kelib yig‘ma temirbeton zavodlarida nuqsonli maxsulotlar, beton va temirbeton buyumlar chiqindilarining juda katta hajmlari yig‘ilib qolgan edi. Masalan, Moskva shaxrining o‘zida 16 ta konditsion bo‘lmagan materiallarni qayta ishlashga mo‘ljallangan liniyalar ishga tushirilgan edi, biroq tabiiy toshdan olinuvchi biroz arzonroq bo‘lgan chaqiq toshning qo‘llanilishi iqtisodiy jihatdan samaraliroq bo‘lgani uchun ularning ko‘pchiligining ishini to‘xtatilishiga olib keldi.

1980-90 yillarda MDH mamlakatlarida ma’naviy va jismoniy jihatdan eskirgan uy-joy fondini yangilash jarayoni boshlandi. Birinchi navbatda yirik shaharlardagi rekonstruksiya qilinmaydigan K-7-3, P-14, P-32, I-510 va boshqa seriyalardagi besh qavatli uylar buzilishi lozim bo‘ldi. Biroq, buzilishga va qismlarga ajratishga mo‘ljallangan ushbu binolar hajmining kattaligi ularni utilizatsiya qilish bo‘yicha tezkor choralar ko‘rilishini taqazo qildi. Mo‘ljal bo‘yicha 10-12 mln. t qurilish lomi va chiqindilari utilizatsiya qilinishi va 4-5 mln. t ikkilamchi to‘ldiruvchilar ishlab chiqarilishi ko‘zda tutilgan edi.

Umumdavlat yoki, shahar masshtabida qaraganda, umumshahar miqyosidagi foyda cheklangan transportlash marshrutiga ega mahalliy xom ashyodan foydalanish, qurilish lomini ko‘mish uchun maydonlar ajratishni bekor qilish yoki qisqartirish, qayta ishlash joyida bir qism chaqiq toshni obodonlashtirish va to‘shamalar uchun, hamda ko‘pincha yetkazib berish xarajatlari o‘zining narxiga nisbatan ancha qimmat bo‘lgan tabiiy to‘ldiruvchilarning o‘rniga ikkilamchi to‘ldiruvchilarni ishlatishga asoslanadi.

Qurilish amaliyoti shuni ko‘rsatib berdiki, kerakli sifatga ega bo‘lgan chaqiq toshni olish uchun bino va inshootlarni texnik, texnologik va ekologik holatini zamonaviy uslublar, shu jumladan yemirmaydigan uslublar yordamida dastlabki bevosita tekshiruvdan o‘tkazishni taqazo qiladi. Faqat bino va inshootlar elementlarini bo‘laklarga ajratish va ularni saralash, bo‘laklarni birlamchi tayyorlash, keyinchalik burdalash, saralash va omborlash orqali ishlab chiqarishning barcha bosqichlarida sifatni nazorat qilish postlari va tegishli me’yoriy hujjatlar mavjud bo‘lgandagina zamonaviy qurilish talablariga muvofiq keluvchi chaqiq tosh olinishi mumkin.

Mahalliy ishlab chiqaruvchilar va ilg‘or xorijiy korxonalar tajribasini umumlashtirish burdalangan betonni beton qorishmasini tayyorlashda to‘ldiruvchi sifatida qo‘llashga yo‘l qo‘yish imkoniyalarini ochib berdi (GOST 26633-85). Shu bilan bir vaqtda beton chiqindilari va nokonditsion temirbetonni utilizatsiya qilish masalalari bo‘yicha tegishli talablar amaliyotga kiritildi (OTNP-7-85).

Dunyoning ilg‘or mamalakatlari tajribasiga to‘xtalsak, amerikaning beton to‘ldiruvchilari uchun standartlari spesifikatsiyasi gidravlik bog‘lovchilar asosidagi betonning burdalaridan olinuvchi chaqiq toshni o‘z ichiga oladi. Yaponiya va Niderlandiya mamlakatlari ham hozirgi kunga kelib betonning burdalaridan olinuvchi to‘ldiruvchilarga standartlarni amalga kiritdilar. Yaponiya standartlariga muvofiq ikkilamchi beton uchta toifaga bo‘linadi (1.1-jadval) [2] :

1-toifa – oddiy mayda to‘ldiruvchi + ikkilamchi yirik to‘ldiruvchi;

2-toifa - oddiy va ikkilamchi mayda to‘ldiruvchi + ikkilamchi yirik to‘ldiruvchi;

3-toifa – ikkilamchi mayda va ikkilamchi yirik to‘ldiruvchi.

Ovropa iqtisodiy hamjamiyati mamlakatlarida qurilishda beton lomining chiqindilarini qo‘llash bo‘yicha birinchi tadqiqotlar Niderlandiya, Belgiya va Germaniyada o‘tkazilgan. Ushbu mamlakatlar mutaxassislari tomonidan beton chiqindilarining xossalarini o‘rganish bilan birga burdalovchi asbob-uskunalarning turli xillarini: lunjli, konusli, zarbali yoki rotorli-bolg‘ali maydalagichlarni o‘rganishga ham jiddiy e’tibor qaratildi.

Burdalangan betondan olingan chaqiq toshning asosiy fizik-mexanik tavsiflari quyidagi ko‘rsatkichlarga teng bo‘ldi [2] :

Zichligi, kg/m^3...2150-2450;
Burdalanish faktori. .0,7-0,79;
Namligi ,%.3 - 6;
Suv yutuvchanligi, % .4 – 5;
Kuydirgandagi yo‘qotishlari, % 5.

Tadqiqotlarning natijalari yuqorida keltirilgan ikkilamchi to‘ldiruvchilarning betonni xossalariga ta’siri qonuniyatlarini asosan tasdiqlab berdi. Shuning asosida faqat yirik to‘ldiruvchini betonni tayyorlashda ishlatishga tavsiya berildi, chunki uning mustaxkamlikka oid xossalari aynan shunday, lekin shag‘al asosidagi betonning ko‘rsatkichlariga yaqin bo‘ldi (1.2-jadval) [2].

1-jadval

Ikkilamchi betonlardan foydalanish

Ikkilamchi beton toifasi	Qo‘llash sohasi	Siqilishga maksiml mustaxkamligi, MPa	
		loyixaviy	xaqiqiy
1	Umumiy kam qavatli qurilish,kam qavatli uy-joy qurilishi, xuddi shu yakka tartibdagi, ombor va ishlab chiqarish xonadonlari poydevorlari	18	30
2	Poydevorlarning beton bloklari, garajlar va yengi yordamchi xonalar, mashina va mexanizmlar staninasi	15	27
3	Darvozalar yog‘och konstruksiyalari poydevorlari, devorlar, mashina va mexanizmlar ostiga yengil poydevorlar	12	24

Ikkilamchi to‘ldiruvchi va boshlang‘ich shag‘al asosida olingan betonlarning fizik-mexanik tavsiflari

Tavsiflari	Shag‘aldagi boshlang‘ich beton	Shag‘aldagi ikkilamchi beton	Shag‘aldagi boshlang‘ich beton	Shag‘aldagi ikkilamchi beton
Sement sarfi,kg/m3	263	285	370	411
Suv-sement nisbati, -	0,6	0,63	0,43	0,45
Zichlik, kg/m^3	2333	2243	2344	2267
28 sutkalik muddatda siqilishga mustaxkamlik,MPa	30,6	33,1	53,4	57,1
Maksimal deformatsiyalar, %	2,4	2,7	1,9	3,2
Elastiklik moduli, MPa	30100	27900	37400	30800

Shunday qilib, burdalangan betondan olingan chaqiq toshdan to‘ldiruvchi sifatida shag‘aldan foydalanish tavsiya qilinuvchi betonning tarkibida foydalanish mumkin deb topildi.

Respublikamizda va xorijiy mamlakatlarda to‘plangan tajribani tahlil qilish natijasida quyidagi xulosani chiqarish mumkin-ki, bunga asosan beton lomini qayta ishlashdan olingan ikkilamchi chaqiq tosh kelish yo‘llari va kamqatnov yo‘llarning to‘shama qatlamini qurishda, omborxona, ishlab chiqarish xonalari va katta bo‘lmagan mexanizmlar ostiga poydevorlar qurishda, turli asoslarni barpo qilishda foydalanish tavsiya etiladi.

Burdalangan betonni qo‘llash amaliyotida nokonditsion buyumlarni yemirish natijasida olinuvchi materialning fraksion tarkibi muhim axamiyat kasb etadi. Masalaning mohiyati, yirik to‘ldiruvchiga o‘lchamlari bo‘yicha mos keladigan fraksiyalarning miqdorini aniqlab berishdan iborat hisoblanadi. Bunday ajratib berishning zarurati shu bilan bog‘liqki, respublikamizdagi va xorijiy malakatlardagi eksperimental ma’lumotlarning tahlili mayda to‘ldiruvchi sifatida burdalangan betondan foydalanib olingan betonlarning ekspluatatsion tavsiflari har doim ham yomonroq bo‘lganini ko‘rsatib berdi.

O‘tkazilgan eksperimental tadqiqotlarda [6]UPN-7 qurilmasida mustaxkamligi 20 MPa ga teng bo‘lgan og‘ir betondan iborat nokonditsion buyumlarni yemirish natijasida olingan yemirilgan betonni tadqiqot qilish natijalari keltirilgan.

Yemirilgan buyumlarning boshlang‘ich betonining tarkibi quyidagicha:

a) ichki devor paneli 5V: potrlandsement: M400 -330 kg; qum : Mkr= 2,0 – 795 kg; chaqiq tosh : 5-20 mm bo‘lgan fraksiyali – 1084 kg; suv -192 l; LST qo‘shimchasi – 0,4 %.

b) tashqi devor paneli 5N: potrlandsement: M400 - 280 kg; qum : Mkr= 2,0 – 737 kg; chaqiq tosh : 5-20 mm bo‘lgan fraksiyali – 1192 kg; suv -184 l; LST qo‘shimchasi – 0,5 %.

3. Xulosa

1.Poydevor bloklari va devorbop toshlar ishlab chiqarish uchun ikkilamchi chaqiq tosh va maxalliy M400 markali sement asosidagi betonlarning tarkiblari ishlab chiqildi. Ushbu betonlarning mustahkamlik bo‘yicha sinflari: V7,5; V10;V12,5; V15 bo‘lib qorishmaning harakatchanligi konus cho‘kishi bo‘yicha KCh=2-4 sm tashkil qiladi.

2.“Toshkent Teknologik Qurilish” MChJda beton lomidan olingan ikkilamchi chaqiq tosh asosida me’yoriy xujjatlar talablariga mos keluvchi ko‘rsatkichlarga ega bo‘lgan beton olish imkoniyati mavjudligi isbotlandi. Taklif qilingan tarkib bo‘yicha beton lomidan olingan chaqiq tosh asosidagi betondan 32 dona bino podvollari devorlari uchun FBS 12.4.6-T markali beton bloklari tayyorlandi.

4. Beton lomidan olingan chaqiq tosh asosida ishlab chiqilgan tarkib va texnologiyani “Toshkent Teknologik Qurilish” MChJda ishlab chiqarishga joriy etilishidan olinadigan iqtisodiy samara 1 m^3 yig‘ma beton uchun 50,2 ming. so‘m bir yilda esa 321,3 mln. so‘mni so‘mni tashkil etadi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Salixanov Saidxon Salixanovich /	Toshkent davlat transport universiteti “Ko‘priklar va tonnellar” kafedrasi Professor, Texnika fanlari nomzodi, E-mail: Salixanov@tstu.uz Tel.:+998909759000 https://orcid.org/0000-0001-5322-3150
Kenjayev Temurbek Olimjonovich /	Toshkent davlat transport universiteti “Ko‘priklar va tonnellar” kafedrasi Tayanch doktaranti. E-mail: Temurkenjaev0104@gmail.com Tel.:+998901340104 https://orcid.org/0009-0000-2152-0468

Model of a multi-agent system for monitoring aeronautical information transmission network

N. M. Turaeva[1][a]
[1]Tashkent University of Information Technologies, Tashkent, Uzbekistan

Abstract: The purpose of the work in this article is to develop models and algorithms to ensure the effectiveness of monitoring the telecommunications network of information transmission in air navigation systems, allowing to systematize and improve the efficiency of the work of employees of the Department of the data transmission network of the aviation industry of Uzbekistan. The relevance of the development of this model is to use intelligent agents to help operators quickly enough to recognize a potential problem and help prevent a wide range of real failures. The development of a model of a network monitoring system based on multi-agent technology was completed and the function of each agent in the system was described. During the development, the formation and stages of operation of the multi-agent technology were studied. The practical results of the study of the work are that the proposed software and hardware for monitoring the transmission of aeronautical information in the airport telecommunications networks were successfully implemented and the efficiency of the network has increased significantly

Keywords: imitation modeling, multi-agent system, air navigation, telecommunication network, Python, SimPy, AnyLogic, systems modeling

Модель многоагентной системы мониторинга телекоммуникационной сети передачи аэронавигационной информации

Тураева Н.М.[1][a]
[1]Ташкентский университет информационных технологий, Ташкент, Узбекистан

Аннотация: Целью работы в данной статье является разработка моделей и алгоритмов обеспечения эффективности мониторинга телекоммуникационной сети передачи информации в аэронавигационных системах позволяющее систематизировать и повысить оперативность работы сотрудников Управления сети передачи данных авиационной отрасли Узбекистана. Актуальность разработки данной модели, заключается в использовании интеллектуальных агентов, чтобы помочь операторам достаточно быстро распознать потенциальную проблему и помочь предотвратить широкий спектр реальных сбоев. Выполнена разработка модели (схемы) сетевой системы мониторинга на основе многоагентной технологии и описана функция каждого агента в системе. В ходе разработки были изучены формирование и этапы работы многоагентной технологии. Практические результаты исследования работы заключается в том, что предложенные программные и технические обеспечения системы мониторинга передачи аэронавигационной информации в телекоммуникационных сетях аэропорта были внедрены успешно и эффективность функционирования сети значительно повысилась.

Ключевые слова: имитационное моделирование, многоагентная система, аэронавигация, телекоммуникационная сеть, Python, SimPy, AnyLogic, моделирование систем

1. Введение

Для достижения реализации системы мониторинга передачи аэронавигационной информации на основе многоагентных технологий можно выбрать проблемно-структурную методологию синтеза гибридных систем, которая позволяет создавать самоорганизующиеся модели, каждый элемент которых развивается, получая данные и знания от других элементов [1].

Разработка системы мониторинга является объемным и сложным процессом, включающим в себя целый алгоритм действий, либо по-другому – этапов [2].

Данное исследование в определенной степени служит выполнению задач, предусмотренных в Постановлении Президента Республики Узбекистан №ПП-4699 «О мерах по широкому внедрению цифровой экономики и электронного правительства» от 28 апреля 2020 г., Указе №УП-6079 «Об утверждении стратегии «Цифровой Узбекистан-2030» и мерах по ее эффективной реализации» от 5 октября 2020 г., Указе №УП-5349 «О мерах по дальнейшему

[a] https://orcid.org/0000-0003-4586-7401

совершенствованию сферы информационных технологий и коммуникаций» от 19 февраля 2018 г., в Постановлении Кабинета Министров Республики Узбекистан №699 «О мерах по дальнейшему развитию телекоммуникационной инфраструктуры Республики Узбекистан» от 19 ноября 2021 г., Постановлении №185 «О мерах по дальнейшему улучшению качества услуг связи, информатизации и телекоммуникаций» от 7 марта 2018 г. и в других нормативно-правовых документах, принятых в данной сфере.

2. Методика исследования

Для разработки новой мониторинговой системы для телекоммуникационных сетей передачи аэронавигационной информации выбрали именно эту технологию – многоагентную систему мониторинга. [3,4] Новая модель системы мониторинга разработается с использованием интеллектуальных агентов, чтобы помочь операторам сети достаточно быстро распознать потенциальную проблему и помочь предотвратить широкий спектр реальных сбоев.

В ходе исследования были изучены научно-исследовательские труды учёных и работы авторов других стран, таких как А.В. Березина «Разработка мультиагентной системы мониторинга сетевого оборудования», Шамин И.М. «Мониторинг IT-систем и сетевых устройств», А.В. Боговик, Д.М. Сафиулов «Анализ существующих систем мониторинга технического состояния телекоммуникационного оборудования сетей связи», Князева Г.В. «Мониторинг действий пользователя как часть системы комплексной безопасности компьютерных систем», Гирик А.В. «Организация мониторинга в телекоммуникационных сетях с целью обнаружения информационных угроз безопасности передачи данных», Дакуева Э.Р. «Исследование и внедрение системы мониторинга деятельности предприятия», Thomas Lindh «Performance monitoring in communication networks», Abul Bashar «Graphical modelling approach for monitoring and management of telecommunication networks», Anand Sreenivasan «Performance monitoring of network systems», Colin Goldsmith «Wireless local area networking for device monitoring», Andrej Novak «Modern telecommunication networks in the Aeronautical Telecommunication Network (ATN)», Vishrant Tripathi «Information freshness for monitoring and control over wireless networks». В процессе иследования диссертацинной работы были изучены труды учёных и работы авторов Узбекистана таких как, проф.Исаев Р.И. «Мультимедийные сети связи», М.Абдужаппарова, С.Садчикова «Internet tarmoqlari va xizmatlari», Xalikov A.A., Abdujapparova M.B. «Telekommunikatsiya tarmog‘iga keng polosali kirishning o‘tkazish qobiliyatini baholash usulini ishlab chiqish», Эшанкулов Х.И. «Многоагентные системы для информационного мониторинга и управления в реальном времени», Гулямов Ж. «Система диспетчеризации и мониторинга инженерных систем», Расулова Н., Дусейнов Н. «A multi-agent approach to creation of adaptive intelligent learning systems», Шарипов Д. К. «Модели и алгоритмы систем мониторинга и прогнозирования загразнения атмосферы в промышленных регионах», Худаяров М. Б. «Мониторинг энергопотребления для оценки энергоэффективности общественных зданий», Ю.В. «Методы и устройства дистанционного мониторинга», Насруллаев Н.Б. «Ахборот хавфсизлиги мониторинги тизими ишлашининг самарадорлигини ошириш усуллари ва алгоритмлари». Вышеуказанных работах по отчетам, расчетам и изучению объекта получена информация [5], подтверждающая о проведенных исследованиях по мониторингу сети передачи данных, а также по другим сферам, такие как наземный транспорт, образование, логистика, бизнес-аналитика и т.д. [6]

Проведенный анализ исследований в области системы мониторинга телекоммуникационных сетей передачи аэронавигационной информации [7,8] показывает, что в работах вышеперечисленных ученых в недостаточной степени изучены вопросы, посвященные разработке методов, моделей и алгоритмов системы мониторинга сети передачи аэронавигационной информации на основе многоагентной технологии, обеспечивающая высокую надежность и оперативность обмена информацией между операторами.

В процессе научного исследования создано программное обеспечение, которое будет имитировать работу сложной системы, отвечающей за мониторинг передачи данных в сфере авиации. Эта система должна быть способна моделировать различные сценарии, от нормальной работы до экстремальных ситуаций, и предоставлять ценную информацию для оптимизации и улучшения реальной системы.

Актуальность разработки данной модели, заключается в использовании интеллектуальных агентов, чтобы помочь операторам достаточно быстро распознать потенциальную проблему и помочь предотвратить широкий спектр реальных сбоев.

В качестве агентов предложено использовать следующие: агент информационного уведомления в центральный компьютер, агент сбора и сортировки данных, агент отслеживания телекоммуникационного оборудования, агент блока электропитания, агент формирования базы данных, агент метеорологических данных, агент справочников.

Автором данной научно-исследовательской работы предложена модель сетевой системы мониторинга на основе многоагентной технологии.

Агентное моделирование — это метод, который позволяет создавать модели сложных систем с помощью взаимодействия автономных агентов. В контексте телекоммуникационного оборудования агентное моделирование может быть использовано для анализа, оптимизации и прогнозирования работы различных компонентов телекоммуникационных сетей [9].

Рис.1. Модель сетевой системы мониторинга на основе многоагентной технологии

Разработанная система мониторинга считается интегрированной системой и служит для быстродействия операторов и для эффективной работы сети и телекоммуникационного оборудования. Агенты современной многоагентной технологии способны будут давать рекомендации в разных случаях неполадка сети и при аварийных случаях [10]. Во время тестирования объектов сети, предлагаемая интегрированная система мониторинга будет сама сравнивать результаты тестирования с нормой и оповещать о состоянии какого-либо объекта сети на экране центрального компьютера. На процесс уйдет примерно 2-3 минуты, что значительно сокращает время проверки по сравнению со существующей системой.

Ниже приведен фрагмент кода разработанной программы:

```
Python
import simpy
class Agent:
    def __init__(self, env):
        self.env = env
        # ... другие атрибуты
агента
class Network:
    def __init__(self, env):
        self.env = env
        # ... создание сети
def main():
    env = simpy.Environment()
    network = Network(env)
    # ... создание агентов и
запуск моделирования
    env.run(until=100)
if __name__ == '__main__':
    main()
import simpy
class Aircraft:
    def __init__(self, env):
        self.env = env
        # ... другие атрибуты
телекоммуникационного
оборудования
class GroundStation:
    def __init__(self, env):
        self.env = env
        # ... другие атрибуты
сети передачи аэронавигационной
информации
def main():
    env = simpy.Environment()
    # ... создание объектов и
запуск моделирования
    env.run(until=100)
if __name__ == '__main__':
    main()
```

Ключевые компоненты имитационной модели многоагентной системы мониторинга сети передачи аэронавигационной информации:

- **Агенты:** Отдельные элементы системы (датчики, серверы, клиенты), каждый из которых имеет свои задачи и характеристики.
- **Сеть:** Структура, соединяющая агентов и обеспечивающая передачу данных.
- **Аэронавигационная информация:** Специфические данные, передаваемые по сети (планы полетов, метеоданные, данные о состоянии воздушного судна и т.д.).
- **События:** Различные происшествия, которые могут произойти в системе (отправка сообщения, потеря пакета, отказ оборудования).
- **Модель времени:** Способ представления времени в модели (дискретное или непрерывное).

Выбор инструментов и технологий:

- Язык программирования: Python, благодаря богатой экосистеме библиотек для научных вычислений и моделирования (NetworkX, SimPy, AnyLogic).
- Инструменты для имитационного моделирования:
  - SimPy: Простая в использовании библиотека для дискретного события имитационного моделирования.
  - AnyLogic: Профессиональный инструмент для моделирования сложных систем, включая многоагентные.
  - OMNeT++: Специализированная платформа для моделирования сетей.

- Среда разработки: Любая современная IDE, поддерживающая выбранный язык (PyCharm, Visual Studio Code).

Структура программы.

1. Определение агентов:
   - Создать классы для каждого типа агента.
   - Определить атрибуты (идентификатор, состояние, ресурсы) и методы (обработка событий, взаимодействие с другими агентами).
2. Создание сети:
   - Использовать библиотеку NetworkX для создания топологии сети.
   - Определить каналы связи, задержки и пропускную способность.
3. Имитация времени:
   - Выбрать модель времени (дискретная или непрерывная) и реализовать механизм продвижения времени.
4. События и обработчики событий:
   - Определить все возможные события.
   - Создать функции для обработки каждого события.
5. Сбор данных и анализ:
   - Сохранять данные о состоянии системы в процессе моделирования.
   - Использовать библиотеки для визуализации и анализа данных (Matplotlib, Pandas).

Ключевые аспекты моделирования:

- Аэронавигационная информация: Определить формат и содержание данных (планы полетов, метеоданные, сообщения АТС).
- Протоколы связи: Моделировать используемые протоколы (например, ADS-B, CPDLC).
- Ошибки и сбои: Вводить различные типы ошибок (потеря пакетов, задержка, искажение данных) и моделировать восстановление.
- Нагрузка сети: Генерация различной нагрузки на сеть для оценки ее производительности.
- Контроль сети передачи аэронавигационной информации: Моделирование многоагентной системы мониторинга сети передачи аэронавигационной информации.

Дальнейшие шаги:

- Уточнение требований: Определить конкретные цели моделирования, типы агентов, сценарии и показатели эффективности.
- Выбор инструментов: Определить наиболее подходящие инструменты для реализации проекта.
- Разработка детальной архитектуры: Создать диаграммы классов и последовательностей для визуализации структуры системы.
- Реализация: Поэтапно реализовать отдельные компоненты системы и интегрировать их.
- Тестирование и отладка: Провести тщательное тестирование для выявления и исправления ошибок.
- Анализ результатов: Проанализировать полученные данные и сделать выводы.

Дополнительные возможности:

- Визуализация: Использование библиотек для создания интерактивных визуализаций.
- Верификация и валидация: Сравнение результатов моделирования с реальными данными.
- Оптимизация: Поиск оптимальных параметров системы.

Машинное обучение: Применение методов машинного обучения для прогнозирования и анализа данных.

3. Результаты исследования

Таким образом, агентное моделирование предоставляет гибкий подход к исследованию динамики телекоммуникационных систем и помогает принимать более обоснованные решения по их управлению и развитию.

Разработанная модель имеет ряд преимуществ как, высокая надежность системы - устойчивость к сбоям и обеспечивает непрерывную работу, точность и синхронизация - все системы и оборудование будет работать синхронно для предотвращения ошибок. Для обеспечения вышеуказанных и была необходимо создать интегрированную систему мониторинга для отслеживания работоспособности сети передачи аэронавигационной информации.

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Информация о авторах/ Information about the authors

Turayeva Nasiba Mirxamidovna /	Toshkent axborot texnologiyalari universiteti, mustaqil izlanuvchi, E-mail: t.nasiba@gmail.com Tel: +998971558474 https://orcid.org/0000-0003-4586-7401

Analysis of the essence of financial flows in the supply chain

G.A. Samatov [1][a], M.S. Burikhodjaeva[1][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: In the context of the reproductive cycle within the supply chain, managing the costs and results of activities of individual enterprises is an urgent scientific task, since it determines the level of competitiveness of enterprises in the domestic economy and their viability in the struggle for the consumer. Logistics, which is a systematic factor in efficiency, and on this basis, the total costs of supply chains of enterprises should be one of the main roles in the environment. In order to effectively manage costs, it will first be necessary to determine the economic content of the Central material and flow and its structure, which is the main purpose of this study.

Keywords: Logistic approach, reproduction process, material flow, economic flow, financial flow, economic transformation, cost accounting, results accounting, analysis of economic transformation

Yetkazib berishlar zanjirida moliyaviy oqimlarning mohiyatini tahlil qilish

Samatov G.A.[1][a], Burixodjayeva M.S.[1][b]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Yetkazib berishlar zanjiri tarkibidagi reproduktiv sikl sharoitida alohida korxonalarning xarajatlari va faoliyat natijalarini boshqarish dolzarb ilmiy vazifa hisoblanadi, chunki u ichki iqtisodiyotdagi korxonalarning raqobatbardoshlik darajasini va ularning iste’molchi uchun kurashida hayotiyligini belgilaydi. Samaradorlikning tizimli omili bo‘lgan logistika va shu asosda korxonalar yetkazib berish zanjirlarining umumiy xarajatlari atrof-muxitdagi asosiy rollardan biri bo‘lishi kerak. Xarajatlarni samarali boshqarish uchun birinchi navbatda, ushbu tadqiqotning asosiy maqsadi bo‘lgan markaziy moddiy - oqimning iqtisodiy mazmunini va uning tuzilishini aniqlash kerak bo‘ladi.

Kalit so‘zlar: Logistik yondashuv, takror ishlab chiqarish jarayoni, moddiy oqim, iqtisodiy oqim, moliyaviy oqim, iqtisodiy transformasiya, xarajatlarni hisobga olish, natijalarni hisobga olish, iqtisodiy transformasiyani tahlil qilish

1. Kirish

Shakllangan yaxlit logistika xududining tarkibiy qismlaridan biri bo‘lgan korxonaning funkstional faoliyatini batafsil tahlil qilish natijasida ishlab chiqarish korxonasi moddiy oqimining iqtisodiy mazmunini o‘zgartirish, yetkazib berishlar zanjiri tuzilishi va ko‘payish sikli tizimidagi qiymatini ifodalashning asosiy shakllari ko‘rsatilgan bo‘lishi kerak. Shu asosda xarajatlarning yangilangan tarkibi taqdim etiladi, ulardan hosil bo‘lgan natijalar bilan bir qatorda logistika oqimlarining iqtisodiy o‘zgarishi dinamikada belgilanadi. Korxonada aniqlangan xarajatlar, yo‘qotishlar va samaradorlik ko‘rsatkichlarining tarkibi boshqaruv hisobini tashkil etishning bir qator talablari va xususiyatlarini belgilaydi. Natijada, ushbu tadqiqot shakllanishning dolzarbligini asoslaydi va oddiy, kengaytirilgan yetkazib berishlar zanjiri tarkibidagi yagona siyosat bo‘yicha xarajatlar hisobini tashkil etishdagi asosiy to‘siqlarni aniqlaydi, shuningdek ushbu sohadagi ilmiy tadqiqotlarning asosiy vazifalarini belgilaydi.

Hozirgi vaqtda aniq ehtiyojlarni qondirishga yo‘naltirilgan mahsulotni yaratish jarayonida yuzaga keladigan xarajatlarni boshqarish dolzarb muammo hisoblanadi. Bunday holda, biz nafaqat alohida korxonalarning xarajatlari, balki asosan yetkazib berishlar zanjirlari va natijada reproduktiv sikl tizimidagi xarajatlar to‘g‘risida fikr yuritamiz.

2. Tadqiqot metodikasi

Bunday keng kontekstda xarajatlarni boshqarish zarurati, birinchi navbatda, zamonaviy iqtisodiyotning voqyeliklari bilan bog‘liq: korxonalarning iste’molchilar uchun raqobatbardosh kurashi, iqtisodiyot sohasini tartibga soluvchi qonun hujjatlari, O‘zbekiston Respublikasi tashqi siyosati va tashqi iqtisodiy holat va boshqalar bilan bog‘liq. Ushbu kontekstdagi asosiy rollardan biri, shubhasiz, samaradorlikning tizimli omili bo‘lgan logistika, birinchi navbatda shu asosda ta’minot zanjiri korxonalarining umumiy xarajatlariga tegishli bo‘lishi kerak.

Bunday keng kontekstda xarajatlarni boshqarish zarurati, korxonalarning iste’molchilar uchun raqobat kurashi, iqtisodiy sohani tartibga soluvchi qonun hujjatlari,

[a] https://orcid.org/0009-0007-4122-8406
[b] https://orcid.org/0000-0002-9396-4428

O‘zbekiston Respublikasining tashqi siyosati va tashqi iqtisodiy holati birinchi navbatda, zamonaviy iqtisodiyotning voqyeliklari bilan belgilanadi. Ushbu kontekstdagi asosiy rollardan biri, shubhasiz, logistikaning o‘zi va shu asosda yetkazib berishlar zanjiri korxonalarining umumiy xarajatlari samaradorligining tizimli omili bo‘lgan logistikaga tegishli bo‘lishi kerak.

Shuni ta’kidlash kerakki, ilmiy adabiyotlarda logistika oqimlarining iqtisodiy o‘zgarishini ko‘rib chiqishga, takror ishlab chiqarish jarayonini tahlil qilish va boshqarishga logistik yondashuvga umuman va unga jalb qilingan xo‘jalik yurituvchi subyektlarning integrasiyasining alohida darajalariga juda kam e’tibor beriladi, ularning asosiysi ishlab chiqarish korxonasidir. Bir nechta fundamental nashrlarni, shu jumladan ushbu masalaga bag‘ishlangan nashrlarni ta’kidlash kerak, shuningdek, bizning fikrimizcha, logistika oqimining iqtisodiy mazmunini chuqur o‘rganish va keyinchalik uning tuzilishini boshqarishni tashkil etish korxonada, yetkazib berishlar zanjirida va reproduktiv sikl tarkibida amalga oshiriladi1.

Logistik yondashuv asosida tashkil etilgan ishlab chiqarish korxonasining faoliyati, birinchi navbatda, korxonaning moddiy oqimlarini texnologik, iqtisodiy o‘zgartirishni o‘z ichiga olgan murakkab tizimli jarayon sifatida qaraladi. Ishlab chiqarish jarayonida texnologik o‘zgarish resurslarni, mehnat obyektlarini tayyor mahsulotga aylantirishdan boshqa narsa emas. Iqtisodiy transformasiya-bu mahsulotni ishlab chiqarish jarayonida xarajatlarni amalga oshirish va to‘plash, korxona faoliyati natijasini yig‘ish, keyingi yoki ishlab chiqarish iste’moli (xarajatlari) uchun mo‘ljallangan.

Shunday qilib, iqtisodiy transformasiya-bu xarajatlarni (resurslarning iste’mol qilingan qiymatini) yakuniy natijaga (mahsulotning yangi yaratilgan qiymatiga) aylantirishdir.

Korxonaning ishlab chiqarish faoliyatining bunday talqini bizga korxona ichida qiymatni aks ettirishning turli shakllarini aniqlashga imkon beradi. Birinchidan, bu ishlab chiqarish va yakuniy iste’mol sohasida vujudga keladigan va keyingi iste’mol uchun resurslarning maqsadidan dalolat beruvchi qiymatni aks ettirishning resurs shaklidir. Qiymatni aks ettirishning ushbu shakli korxonaning kirish qismidagi material oqimi uchun xosdir. Qiymatni aks ettirishning ikkinchi shakli haqiqiy ishlab chiqarish bosqichida paydo bo‘ladigan va resurslarni iste’mol qilish natijasini, ya’ni tayyor mahsulotni ifodalovchi mahsulot qiymati deb ataladi.

Shuningdek, tovar shakli bu muomala sohasida paydo bo‘ladigan qiymatni ifodalashining oraliq shakli. Yetkazib berishlar zanjirida ushbu shakl zanjirning alohida bo‘g‘inlari: yetkazib beruvchi, firma, vositachi, iste’molchi o‘rtasida material oqimining harakati jarayonida paydo bo‘ladi. Taqdim etilgan qoidalarni tahlil qilish natijasida quyidagilarni ta’kidlash mumkun: moddiy oqimning iqtisodiy mazmuni-bu o‘z faoliyatini amalga oshirish jarayonida logistika zanjirining alohida bo‘g‘inlari tomonidan boshlangan qiymatni ko‘rsatish shakllarining transformasion jarayonlari to‘plamidir.

Logistika zanjirlari kattaroq tuzilishga reproduktiv sikl tarkibiga kiritilgan -bu yerda yuqorida keltirilgan qiymatni aks ettirishning barcha shakllari ham aniqlangan.

Shunday qilib, ko‘paytirish tizimining bo‘g‘ini sifatida korxona uchun ikkita oqimni kuzatish muhim vazifaga aylanadi: sarflangan xarajatlar oqimi va yaratilgan natijalar oqimi. Xarajatlar oqimi tarkibini aniqlash "xarajatlar" kabi sinonim ko‘rinadigan toifalarni ajratishni talab qiladi.

Olingan natijalarni qayd etamiz. Ushbu tushunchalarning barchasini taqqoslaganda, ularning eng asosiysi "xarajatlar" bo‘lib, ular ishlab chiqarish korxonasining maqsadlaridan qat’iy nazar, har qanday resurslarni haqiqiy iste’mol qilish aktlari to‘plami sifatida tushunilishi kerak. O‘z navbatida, xarajatlar resurslar va omillardan maqsadli foydalanishni, resurslar qiymatini va yaratilayotgan mahsulot qiymatining omillarini bevosita tavsiflaydi. Xarajatlar korxona faoliyati bilan bog‘liq xarajatlar bilan ifodalanadi, shu jumladan maqsadli xarakterdagi xarajatlarga qo‘shimcha ravishda, korxona jarayonlarini bajarish paytida yetkazilgan va maqsadli bo‘lmagan zarar. O‘z navbatida, korxona xarajatlari asosiy mahsulotlarni ishlab chiqarish va sotish jarayonida resurslarni iste’mol qilishni o‘z ichiga oladi, shuningdek xo‘jalikning muqobil usulini tavsiflaydi.

Ishlab chiqarish korxonasining moddiy oqimini iqtisodiy o‘zgartirishning markaziy toifasi sifatida xarajatlar batafsilroq ko‘rib chiqiladi. O‘tkazilgan tadqiqotlar natijasida xarajatlarni tabaqalashtirishning zarur mezonlari aniqlanadi, bu samarali boshqarish uchun yetarli tafsilotlarni ta’minlaydi. Ushbu mezonlarga muvofiq xarajatlarni tasniflash 1-jadvalda keltirilgan.

1-jadval

Xarajatlar tasnifi

Tasniflash mezonlari	Xarajatlar guruhlari
Iqtisodiy tarkib	Moddiy, mehnat, amortizasiya va boshqalar
Jarayon - funksiyalarining roli	Asosiy, yordamchi, texnik xizmat
Boshqaruv, nizom	Tartibga solingan, tartibga solinmagan
Qiymat qo‘shish	Samarali, samarasiz

Xarajatlar bilan bir qatorda kompaniya faoliyati davomida yo‘qotishlar shakllanadi, ular ikki guruhga bo‘linadi: shartli va shartsiz. Shunday qilib, xarajatlar va zararlar tarkibini optimallashtirish jarayonida, birinchi navbatda, boshqaruv qarorlari tartibga solinadigan samarasiz xarajatlarni kamaytirish, shartli yo‘qotishlarni kamaytirish va shartsiz yo‘qotishlarni bartaraf etish masalalariga tegishli hisoblanadi.

Keyinchalik tejash maqsadida xarajatlarni aniqlash, hisobga olish va taqdim etish tizimini shakllantirish jarayoni ancha vaqt talab etadi. Ushbu jarayon nafaqat xarajatlarni tahlil qilish operasiyalarining haqiqiy to‘plamini (va olingan natijalarni) qayta injiniring qilishni, balki avtomatlashtirilgan axborot yig‘ish tizimlarini joriy etishni, xarajatlar va yo‘qotishlarni tahlil qilishni, xodimlarni o‘qitishni va boshqalarga yo‘naltirilgan MMT maxsus modullari to‘plamini ishlab chiqishni talab qiladi. Aslida korxona oldida to‘liq hisoblangan xarajatlar va yo‘qotishlarni ko‘p o‘lchovli tabaqalash vazifasi turibdi, natijada esa bu o‘z-o‘zidan katta xarajatga olib keladi. Shuni alohida ta’kidlash kerakki, real vaqt rejimida iqtisodiy o‘zgarishlarni kuzatish har doim ham zarur emas va

ko‘pincha bu keng turdagi mahsulotlarni ishlab chiqaradigan yirik korxonalar uchun mos keladi. Shuni ta’kidlash kerakki, bir qator muammolar so‘nggi o‘n yillikda tadqiqot etilgan va ularni hal qilishning taklif qilingan usullari hozirgi kungacha o‘z ahamiyatini yo‘qotmagan.

Boshqaruv hisobini tashkil qilishda, birinchi navbatda, logistikaning funksional sohalari kontekstida yuzaga keladigan xarajatlar va yo‘qotishlarni taqsimlash kerak (kelib chiqish joyi bo‘yicha buxgalteriya hisobi), ikkinchidan, ma’lum bir mahsulotni ishlab chiqarish jarayonida hosil bo‘lgan xarajatlar va yo‘qotishlarni ifodalash kerak (obyektlar bo‘yicha hisobga olish), uchinchidan, eng muhimi, o‘zaro bog‘liqlikni aniqlash va rivojlanayotgan xarajatlar va zararlarning o‘zaro bog‘liqligi kerak.

Xarajatlar va yo‘qotishlarni aniqlash va tuzish natijalari ichki hisobotlar shaklida ham, diagrammalar, grafikalar, ta’lim xaritalari shaklida ham taqdim etilishi mumkin, tahlil qilish va korxonaning o‘ziga nisbatan tejash maqsadida ma’lumotni yanada vizual shaklda taqdim etish kerak. Shuni ta’kidlash kerakki, xarajatlarni hisobga olish moddiy oqimning iqtisodiy o‘zgarishini hisobga olishning tarkibiy qismlaridan biridir.

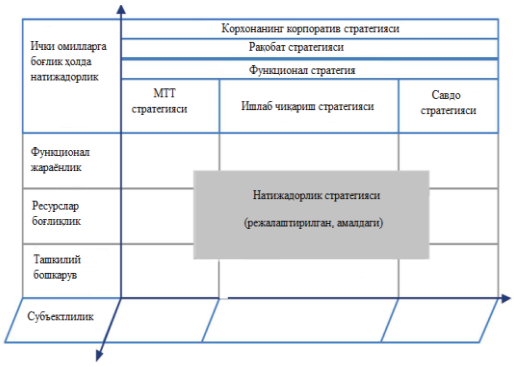
Ikkinchi komponent-natijalarni, aniqrog‘i, kompaniya faoliyatining samaradorligini kuzatish. Ichki samaradorlik ko‘rsatkichlarining tuzilishi integrasiyalashgan logistika maydoni tomonidan belgilanadi, bu yerda jarayon-funksional komponent samaradorligini, resurs komponenti samaradorligini, tashkiliy va boshqaruv komponenti korxona samaradorligini belgilaydi, bu esa logistika strategiyasini amalga oshiradi.

Boshqa tomondan, ushbu ko‘rsatkichlarga erishish darajasi iste’molchilar guruhlarining qoniqishini baholash kontekstida, boshqacha qilib aytganda, korxona faoliyatini baholash subyektlari tomonidan belgilanadi[2].

Oxir-oqibat, ishlash va subyektlarga erishish uchun aniqlangan omillar samaradorlikni baholash (1-rasmda keltirilgan) korxonaning strategik samaradorlik ko‘rsatkichlari maydonini tashkil qiladi. Kelajakda korxonaning operasion samaradorligi ko‘rsatkichlari strategik ko‘rsatkichlar doirasi maydonini shakllantirish uchun asos bo‘ladi.

Ishlab chiqarish korxonasining o‘z faoliyati kontekstida reja, boshqa barcha narsalar teng bo‘lganda, samaradorlikning jarayon-funksional omili sifatida namoyon bo‘ladi chunki, birinchi navbatda, iste’molchiga qiymat yaratish uchun asos bo‘lib, jarayonni tashkil etish funksiyasini ifodalaydi.

Yuqorida ta’kidlanganidek, yagona qiymat yaratish tizimiga ishlab chiqarish korxonasi integrasiyalashgan quyi tizimdir. Ushbu qoida shuni anglatadiki, nafaqat korxona katta tizimning bo‘g‘ini, balki korxona xarajatlari va natijalari oddiy va kengaytirilgan yetkazib berishlar zanjiri xarajatlari va natijalarining bir qismini anglatadi. Bundan tashqari, yetkazib berishlar zanjirida xarajatlar va yo‘qotishlarni ko‘paytirishning multiplikativ ta’siri mavjud, bu nafaqat samarasiz xarajatlar, balki alohida korxonalarda yuzaga keladigan zararlar hajmini ham anglatadi.



1-rasm Korxona faoliyatining strategik ko‘rsatkichlari maydoni

Shu sababli, hozirgi vaqtda raqobatning kuchayishi sharoitida yaratilgan qiymatning yagona xarajatlarni boshqarish siyosatini korxonadan tashqarida kengaytirilgan yetkazib berishlar zanjiri darajasiga o‘tkazish kerak. Ushbu funksiya yetkazib berishlar zanjiri operatorining faoliyat sohasiga ko‘proq mos keladi. Ta’minot zanjiri tarkibida markazlashtirilgan xarajatlar va daromad hisobidan foydalanishning oxirgi iste’molchi uchun barcha aniq afzalliklarga ega bo‘lgan holda, mahalliy korxonalarda qo‘llaniladigan xarajatlar tizimlarini muvofiqlashtirish sohasida ko‘plab ichki to‘siqlar va hal qilinmagan muammolar mavjud. Ichki to‘siqlar, birinchi navbatda, yetkazib berishlar zanjiri kompaniyalarining xarajatlar tarkibini ochishga qiziqmasligini, eng muhimi, sheriklariga ham, potensial raqobatchilarga ham asosiy daromad manbalarini o‘z ichiga olishi kerak. Ikkinchidan, boshqaruv hisobini yagona siyosat asosida tashkil etish yetkazib berishlar zanjirining barcha ishtirokchilari uchun xarajatlar va daromadlarni kuzatish va aniqlashning universal usullarini ishlab chiqishni talab qiladi va bu juda qimmat va uzoq muddatli jarayondir. Uchinchidan, agar bunday hisob tizimi yetkazib berishlar zanjiri bo‘ylab amalga oshirilsa, zanjir aloqalari o‘rtasidagi raqobatga obyektiv to‘siqlar va zanjir tarkibiga yangi ishtirokchilarning kirishiga to‘siqlar yaratiladi.

Hisobotlar tizimlarini uyg‘unlashtirish sohasidagi muammolar, birinchi navbatda, ma’lum bir yetkazib berishlar zanjiriga tegishli, ularning hajmi va ishlatiladigan turli xil boshqaruv hisobi va soliq tizimlari, korxonalar tarmoq farqlanishidan kelib chiqadi.

Yuqorida ta’kidlangan muammolarga biz boshqaruv hisobi sohasida keyingi oddiy va keyinchalik kengaytirilgan yetkazib berishlar zanjiri davomida qo‘shma ilmiy tadqiqotlar uchun ustuvorliklar ro‘yxatini qo‘shishimiz kerak.

Aniqlangan muammolar qatoriga boshqaruv hisobini tashkil etish sohasida keyingi hamkorlikdagi ilmiy tadqiqotlar uchun ustuvor vazifalar ro‘yxati qo‘shilishi kerak, keyinchalik esa kengaytirilgan yetkazib berishlar zanjiri uchun:

- takroriy ishlab chiqarish siklida ishlaydigan butun yetkazib berishlar zanjiri bo‘ylab logistika oqimining iqtisodiy mazmuni va tuzilishi dinamikasini o‘rganish va taqdim etish.
- iqtisodiyotni to‘g‘irlaydigan xarajatlar, yo‘qotishlar va natijalar tarkibini aniqlash, yetkazib berishlar zanjirini boshqarish muammolarini hal qilish bo‘yicha logistika oqimlarini o‘zgartirish.

● yetkazib berishlar zanjiri tarkibida boshqaruv hisobining xususiyatlarini aniqlash, shuningdek uni tashkil etishning asosiy bosqichlari va tartiblarini belgilash.

● yetkazib berishlar zanjiri tarkibida yuzaga keladigan xarajatlar, yo‘qotishlar va natijalarni aniqlash, hisobga olish va vizualizasiya qilish vositalarini ishlab chiqish.

3. Xulosa

Xulosa qilish mumkinki, korxonaning funkstional faoliyatini tahlil qilish natijasida ishlab chiqarish korxonasining markaziy moddiy-oqimining iqtisodiy tarkibi, yetkazib berishlar zanjiri tarkibida va reproduktiv sikl tizimida qiymatni aks ettirishning asosiy shakllari aniqlangan va ko‘rib chiqilgan.

Shu asosda xarajatlar va yo‘qotishlarning yangilangan tarkibi taqdim etiladi, ular hosil bo‘lgan natijalar bilan bir qatorda iqtisodiy oqimlarning dinamikada o‘zgarishini belgilaydi. Xarajatlar, yo‘qotishlar va samaradorlik ko‘rsatkichlarining aniqlangan tarkibi korxonada boshqaruv hisobini tashkil etishning bir qator talablari va xususiyatlarini belgilaydi. Nihoyat xarajatlar shakllanishining dolzarbligini asoslaydi, oddiy va kengaytirilgan yetkazib berishlar zanjiri tarkibidagi yagona iqtisodiy siyosat asosida xarajatlar hisobini tashkil etishdagi asosiy to‘siqlarni aniqlaydi, shuningdek ushbu sohadagi ilmiy tadqiqotlarning asosiy vazifalarini belgilab beradi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Samatov Gaffor Allaqulovich /	Toshkent davlat transport universiteti “Transport logistikasi” kafedrasi mudiri, professor, transportlogistikasi@mail.ru Tel.:+998 908269056 https://orcid.org/0009-0007-4122-8406
Burihodjayeva Maloxat Sobitovna /	Toshkent davlat transport universiteti “Transport logistikasi” kafedrasi katta o‘qituvchisi, maloxatburixadjaeva@gmail.com Tel.:+998 971957779 https://orcid.org/0000-0002-9396-4428

Regulation of factors affecting the speeds of freight trains

D.B. Butunov[1][a], S.A. Abdukodirov[1][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: The main goal of the work is to identify the factors affecting the speed of freight trains and systematize them. Factors affecting the established technical standards of freight train movement speed on railway sections and routes were analytically analyzed and their impact levels on the performance of the main indicators of the train movement schedule were determined. As a result, the "Ishikawa" scheme was developed to determine the factors affecting the speed of freight trains. The random factors affecting the speed of the freight train section and route were classified in the section of levels and the tasks of their systematization were proposed.

Keywords: Railway section and direction, section speed, route speed, train movement graph, factor, station

Yuk poyezdlari harakat tezliklariga ta’sir ko‘rsatuvchi omillarni tizimlashtirish

Butunov D.B.[1][a], Abdukodirov S.A.[1][b]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Ishdan asosiy maqsad yuk poyezdlari harakat tezliklariga ta’sir ko‘rsatuvchi omillarni aniqlash va ularni tizimlashtirishdan iborat. Temir yo‘l uchastka va yo‘nalishlari bo‘yicha yuk poyezdlari harakat tezliklarining o‘rnatilgan texnik me’yorlariga ta’sir ko‘rsatuvchi omillar analitik tahlil qilindi hamda ularning poyezdlar harakati grafigi asosiy ko‘rsatkichlari bajarilishiga ta’sir darajalari aniqlandi. Natijada yuk poyezdlari harakat tezliklariga ta’sir ko‘rsatuvchi omillarini aniqlashning “Isikava” sxemasi ishlab chiqildi. Yuk poyezdlari uchastka va marshrut tezliklariga ta’sir ko‘rsatuvchi tasodifiy omillar darajalar kesimida tasniflandi va ularni tizimlashtirish vazifalari taklif etilgan.

Kalit so‘zlar: Temir yo‘l uchastkasi va yo‘nalishi, uchastka tezligi, marshrut tezlik, poyezdlar harakati grafigi, omil, stansiya

1. Kirish

Temir yo‘l transportida poyezdlar harakati grafigi (PHG)ni ishlab chiqish, harakat tezliklari ko‘rsatkichlarining o‘rnatilgan texnik me’yorlari bajarilishi poyezd tuzuvchi va yo‘l davomidagi stansiyalar ish texnologiyalari, temir yo‘l uchastka va yo‘nalishlarining transport jarayonlari texnologiyasi va texnik parametrlari, tashish jarayonida bevosita ishtirok etuvchi ishlab chiqarish korxonalarining xodimlari kasbiy malakalari va intizomi kabi ko‘plab doimiy, texnologik va texnik omillarga bog‘liq [1-4, 7, 10].

Temir yo‘l uchastka va yo‘nalishlarida poyezdlar harakatini tezkor rejalashtirish uchun doimiy, texnik va texnologik omillardan tashqari tashish jarayonida ehtimoliy sodir bo‘ladigan tasodifiy va tabiy omillarni ham hisobga olish, tahlil qilish, baholash va tasniflash muhim ahamiyat kasb etadi. Bunda uchastka va yo‘nalishlar bo‘yicha poyezdlar harakati samarali tashkil etilganligi yuk poyezdlari harakat tezliklarining bajarilish darajasi bilan ifodalanadi [5-9].

Yuk poyezdlari harakat tezliklari temir yo‘l uchastka va yo’nalishlarining transport jarayonlari texnologiyasiga rotsional baho berishda asosiy ko‘rsatkichlardan biri bo‘lib xizmat qiladi [14, 15]. Ularning o‘rtacha qiymati yuklarni belgilangan manzillariga yetkazib berish muddati, yuk tashish uchun sarflanadigan umumiy xarajatlar tannarxi, vagon aylanmasi uchun sarfalanadigan umumiy vaqti, temir yo‘l uchastka va yo‘nalishlarining o‘tkazish qobiliyati, PHG asosiy ko‘rsatkichlari va shu kabi boshqa ko‘rsatkichlar bajarilishiga ta’sir ko‘rsatadi [11, 15, 16].

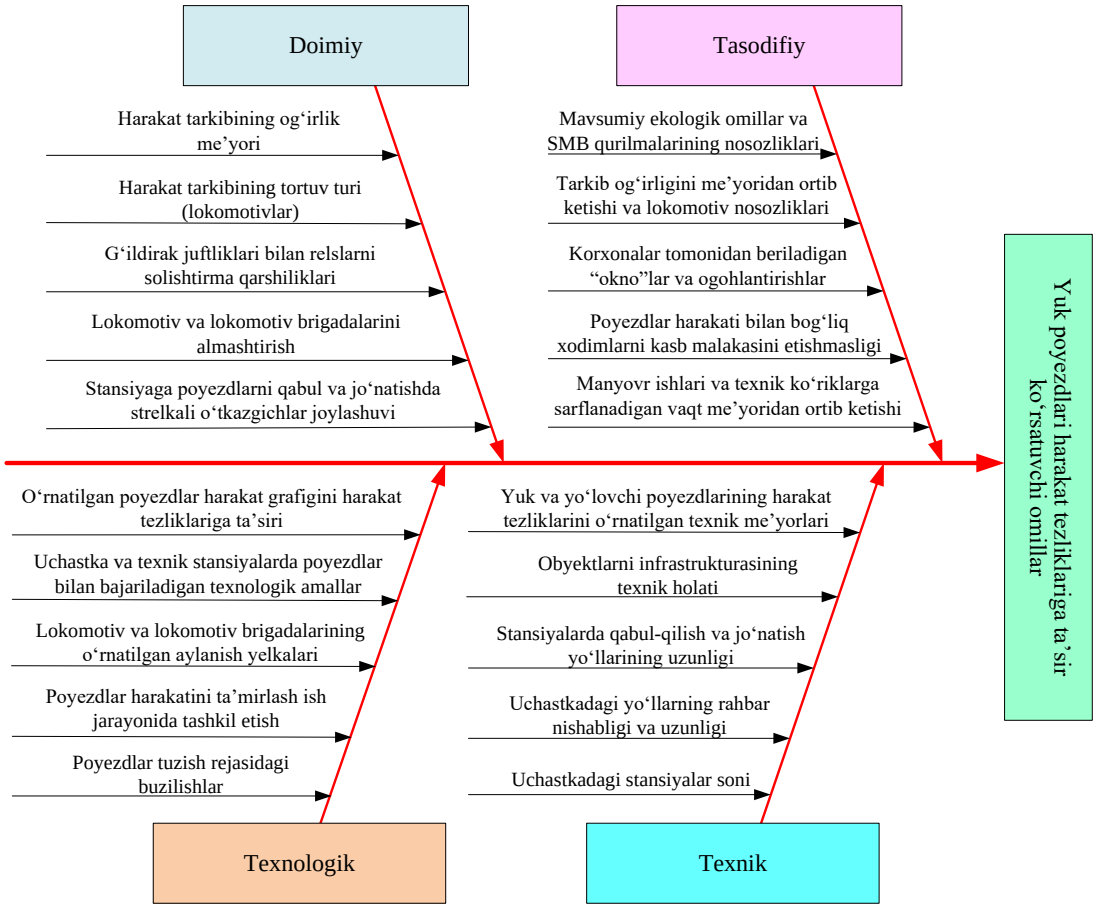
Hozirgi kunda yuk poyezdlari harakat tezliklari Mustaqil davlatlar hamdo‘stligi (MDH) davlatlari temir yo‘llarining byudjet ko‘rsatkichlari tizimiga kiritilgan. Shuning uchun yuk poyezdlari harakat tezliklari ko‘rsatkichlarini oshirish, ularga salbiy ta’sir ko‘rsatuvchi omillarni aniqlash usullarini takomillashtirish, bajarilish darjasini tahlil qilish va baholash hamda o‘rnatilgan me’yoriy qiymatiga doimiy, tasodifiy, texnik va texnologik ta’sir ko‘rsatuvchi omillarni aniqlash, tizimlashtirish va ularni o‘z vaqtida bartaraf etish bo‘yicha tezkor chora-tadbirlarini ishlab chiqish dolzarb masalalardan biri hisoblanadi.

2. Tadqiqot metodikasi

Temir yo‘l uchastka va yo‘nalishlari bo‘yicha yuk poyezdlari harakat tezliklarining o‘rnatilgan texnik me’yorlari bajarilishini baholash va ular qiymatlariga ta’sir

[a] https://orcid.org/0009-0009-4165-0257
[b] https://orcid.org/0000-0001-9457-255X

ko‘rsatuvchi omillarni tahlil qilishda mahalliy va xorijiy olimlar hamda mutaxassislar turli davrlarda ilmiy izlanishlar olib borgan [2, 3, 5, 6-13]. Biroq bu boradagi yondashuvlar turlicha. Shu munosabat bilan temir yo‘l uchastka va yo‘nalishlari bo‘yicha yuk poyezdlari harakat tezliklariga ta’sir ko‘rsatuvchi omillar tadqiq qilindi va natijasi “Isikava” sxemasi ko‘rinishida ifodalandi (1-rasm).



1-rasm. “Isikava” sxemasi yordamida yuk poyezdlari harakat tezliklariga ta’sir ko‘rsatuvchi omillarni aniqlash

Tahlil natijalari (1-rasm)ga ko‘ra, yuk poyezdlari harakat tezliklariga poyezdning og‘irlik me’yori, harakat tarkibining tortuv turi (lokomotivlar), g‘ildirak juftliklari bilan relslarni solishtirma qarshiligi, stansiyaga poyezdlarni qabul qilish va jo‘natishda strelkali o‘tkazgichlar joylashuvlari doimiy ta’sir ko‘rsatuvchi omillar tarkibiga kiradi. Tarkib og‘irligini me’yoridan ortib ketishi va lokomotivlar nosozligi, mavsumiy ekologik omillar, poyezdlar harakati bilan bog‘liq ishchi-xodimlarni kasb malakasini yetishmasligi, manyovr ishlari va texnik ko‘riklarga sarflanadigan vaqt me’yorlaridan ortib ketishi tasodifiy ta’sir ko‘rsatuvchi omillar tarkibiga kiradi.

Yuk va yo‘lovchi poyezdlari harakat tezliklarining o‘rnatilgan texnik me’yorlari, uchastkadagi stansiyalar soni, temir yo‘l yo‘nalishlarining rahbar nishabliklari, stansiyalarda qabul qilish va jo‘natish yo‘llarining uzunligi, temir yo‘l obyektlari infratuzilmasining holatlari texnik ta’sir ko‘rsatuvchi omillar tarkibiga kiradi. Temir yo‘l uchastka va yo‘nalishlari tarkibidagi stansiyalarda poyezdlar bilan bajariladigan texnologik amallar, poyezdlar tuzish rejasi buzilishlari, poyezdlar harakatini ta’mirlash jarayonida tashkil etish va PHG elementlari harakat tezliklariga ta’siri texnologik omillar hisoblanadi.

3. Natija va muhokama

Temir yo‘l uchastka va yo‘nalishlari bo‘yicha yuklari harakat tezliklari ifodalarini [14, 15] tahlil qilish natijasida yuklari harakat tezliklariga ta’sir ko‘rsatuvchi omillar darajalar kesimida tizimlashtirildi. Tizimlashtirish temir yo‘l transporti PHGning asosiy ko‘rsatkichlaridan biri bo‘lgan uchastka va marshrut tezliklari misolida amalga oshirildi. Uchastka tezligini aniqlash ifodasiga [14, 15] birinchi darajali ($O_{uch.1}$) ikki xil omil bilan tavsiflanadi, ya’ni texnik (temir yo‘l uchastkalarining uzunligi (L_{uch})) va texnologik (temir yo‘l uchastkalarida poyezdlarning yurish (t_{yur})), oraliq stansiyalarda poyezdlarning umumiy o‘rtacha turib qolish ($\sum t_{or.st}$) va tezlashish va sekinlashish harakatlari uchun sarflagan ($\sum t_{t/s}$) vaqtlari.

Demak, yuk poyezdlarining o‘rtacha uchastka tezligiga ta’sir ko‘rsatuvchi birirnchi darajali omillar (O_{uch1}) quyidagilardan iborat.

$$O_{uch.1} = \left(L_{uch}, t_{yur}, \sum t_t, \sum t_s, \sum t_{or.st}\right) \quad (1)$$

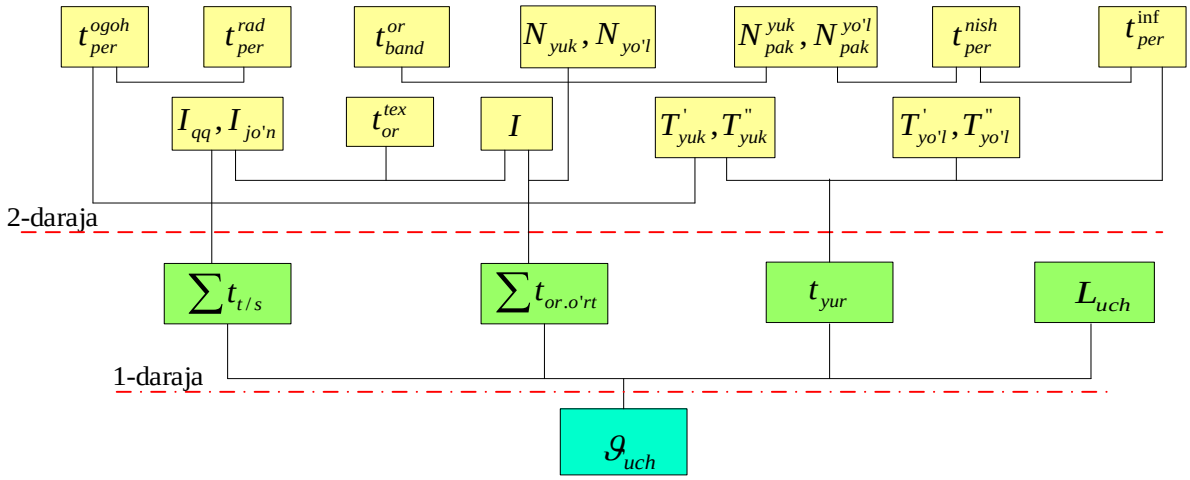
Yuk poyezdlari o‘rtacha uchastka tezligiga ta’sir ko‘rsatuvchi ikkinchi darajali omillarga birinchi darajali

omillar qiymatlarini belgilovchi omillar kiradi. Shunday qilib, poyezdlar harakatiga 2-darajali ta'sir ko'rsatuvchi omillari ($O_{uch.2}$) bilan tavsiflanadi, ya'ni toq va juft yo'nalishlar bo'yicha yuk poyezdlarining yurish vaqtlari (T'_{yuk}, T''_{yuk}), toq va juft yo'nalishlar bo'yicha yo'lovchi poyezdlarining harakatlanish vaqtlari ($T'_{yo'l}, T''_{yo'l}$), temir yo'l uchastkalari bo'yicha yuk va yo'lovchi poyezdlar soni ($N_{yuk}, N_{yo'l}$), temir yo'l uchastkalari bo'yicha yuk va yo'lovchi poyezdlarining paketlab jo'natishlar soni ($N^{yuk}_{pak}, N^{yo'l}_{pak}$), stansiyalarga poyezdlarni qabul-qilish va jo'natishlarda poyezdlararo oraliq interval ($I_{qq}, I_{jo'n}$), PHG bo'yicha poyezdlararo oraliq interval vaqt me'yorlari (I), oraliq stansiyalarida poyezdlar bilan bajariladigan texnologik amallarga sarflanadigan vaqt (t^{tex}_{or}), oraliq stansiyalarning qabul-qilish va jo'natish yo'llarini o'rtacha band qilish uchun sarflandigan vaqti (t^{or}_{band}), peregonlarda ta'mirlash uchun beriladigan ogohlantirish uzunliklariniga sarflanadigan vaqt (t^{ogoh}_{per}), peregonlardagi burilish radiuslarida o'rnatilgan tetzlik bo'yicha harakatlanishi uchun sarflanadigan vaqt (t^{rad}_{per}), peregonlarda rahbar nishabliklar mavjud bo'lgan hududlarni bosib o'tish uchun sarflanadigan vaqt (t^{nish}_{per}) va temir yo'l uchastkalari infratuzilmasining geografik joylashuviga ko'ra poyezdlar harakatini cheklaydigan doimiy ta'sir ko'rsatuvchi masofalarga sarflanadigan vaqtlar (t^{inf}_{per}

Demak, temir yo'l uchastka va yo'nalishlari bo'yicha yuk poyezdlarining o'rtacha uchastka tezligiga ta'sir ko'rsatuvchi ikkinchi darajali omillar quyidagilardan iborat:

$$O_{uch.2} = \begin{pmatrix} T'_{yuk}, T''_{yuk}, T'_{yo'l}, T''_{yo'l}, \\ N_{yuk}, N_{yo'l}, N^{yuk}_{pak}, \\ N^{yo'l}_{pak}, I_{qq}, I_{jo'n}, I, t^{tex}_{or}, \\ t^{or}_{band}, t^{ogoh}_{per}, t^{rad}_{per}, t^{nish}_{per}, t^{inf}_{per} \end{pmatrix} \quad (2)$$

Yuk poyezdlari uchastka tezligiga birinchi va ikkinchi darajalai ta'sir ko'rsatuvchi omillarning tasnifi ishlab chiqildi (2-rasm).



2-rasm. Uchastka tezliklariga ta'sir ko'rsatuvchi omillar tasnifi

Temir yo'l uchastkalarida yuk poyezdlari uchastka tezliklariga birinchi darajali ($O_{uch.1}$) texnik va texnologik ta'sir ko'rsatuvchi omillarning qiymatlari PHG bilan muvofiqligi va rejalashtirilganligi sababli shartli ravishda doimiy deb tasniflanadi. Shartli ravishda doimiy ta'sir ko'rsatuvchi texnik va texnologik omillar uchastka tezliklarining o'rnatilgan texnik me'yorlari qiymatlarini o'rnatishda noaniqlik keltirmaydi, biroq ikkinchi darajali ($O_{uch.2}$) ta'sir ko'rsatuvchi omillar uchastka tezliklarini bajarilish darajasiga ta'sir ko'rsatadi (2-rasm).

Marshrut tezligini aniqlash ifodasiga [5, 14] birinchi darajali ($O_{uch.1}$) ikki xil omil bilan tavsiflanadi, ya'ni texnik (temir yo'l yo'nalishlarining uzunligi ($L_{yo'n}$) va texnologik (temir yo'l yo'nalishlarida poyezdlarning harakatlanish vaqtlari ($t^{har}_{yo'n}$)), texnik stansiyalarda poyezdlarning umumiy o'rtacha turib qolish ($\sum T_{tex.st}$), poyezdlarning tezlashish va sekinlashish uchun sarflagan vaqtlari ($\sum t_{t/s}$).

Demak, yuk poyezdlarining o'rtacha marshrut tezligiga ta'sir ko'rsatuvchi birinchi darajali omillar ($O_{m.1}$) quyidagilardan iborat:

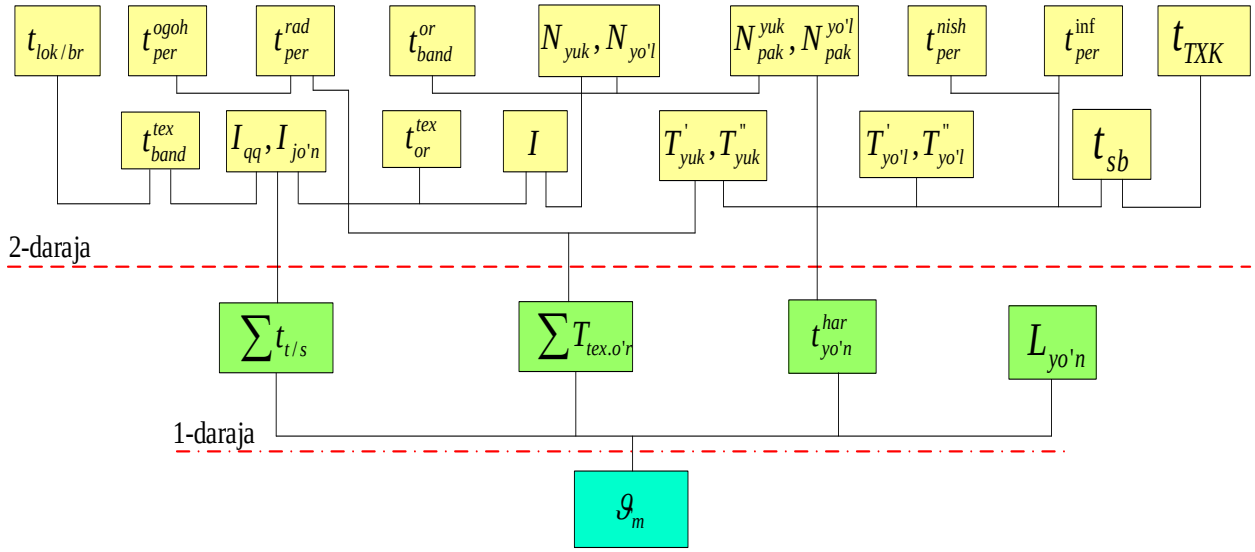
$$O_{m.1} = \begin{pmatrix} L_{yo'n}, t^{har}_{yo'n}, \sum t_t, \\ \sum t_s, \sum T_{tex.ost} \end{pmatrix} \quad (3)$$

Temir yo'l yo'nalishlari bo'yicha yuk poyezdlari o'rtacha marshrut tezligiga salbiy ta'sir ko'rsatuvchi ikkinchi darajali omillarga birinchi darajali omillar qiymatlarini belgilovchi omillar kiradi. Shunday qilib, ikkinchi darajali ($O_{m.2}$) doimiy, texnik va texnologik ta'sir ko'rsatuvchi omillari bilan tavsiflanadi, ya'ni o'rtacha marshrut tezligiga uchastka tezligining ikkinchi darajali ta'sir ko'rsatuvchi omillari, temir yo'l yo'nalishlari tarkibidagi stansiyalarda lokomotiv brigadalarini almashtirish vaqti ($t_{lok/br}$), poyezdlarni texnik ko'riklar uchun sarflanadigan vaqt (t_{TXK}), lokomotiv brigadalarini almashtirish uchun sarflanadigan vaqt (t_{sb}), stansiyalarga qabul-qilish va jo'natish yo'llarini o'rtacha band qilish vaqtlari (t^{tex}_{band}).

Demak, temir yo'l uchastkalari va yo'nalishlari bo'yicha yuk poyezdlarining o'rtacha marshrut tezligiga ta'sir ko'rsatuvchi ikkinchi darajali omillar ($O_{m.2}$) quyidagilardan iborat:

$$O_{m.2} = \begin{pmatrix} T'_{yuk}, T''_{yuk}, T'_{yo'l}, T''_{yo'l}, \\ N_{yuk}, N_{yo'l}, N^{yuk}_{pak}, \\ N^{yo'l}_{pak}, I_{qq}, I_{jo'n}, I, \\ t^{tex}_{or}, t^{or}_{band}, t^{ogoh}_{per}, t^{rad}_{per}, \\ t^{nish}_{per}, t^{inf}_{per} lok/br TXK \\ t_{sb}, t^{tex}_{band} \end{pmatrix} \quad (4)$$

Yuk poyezdlari marshrut tezligiga birinchi va ikkinchi darajalai ta’sir ko‘rsatuvchi omillarning tasnifi ishlab chiqildi (3-rasm).



3-rasm. Marshrut tezliklariga ta’sir ko‘rsatuvchi omillar tasnifi

Temir yo‘l uchastkalari va yo‘nalishlari bo‘yicha yuk poyezdlari marshrut tezliklariga birinchi darajali ($O_{m.1}$) texnik va texnologik ta’sir ko‘rsatuvchi omillarning qiymatlari PHG bilan muvofiqligi va rejalashtirilganligi sababli shartli ravishda doimiy deb tasniflanadi. Shartli ravishda doimiy ta’sir ko‘rsatuvchi texnik va texnologik omillar marshrut tezliklarining o‘rnatilgan texnik me’yorlari qiymatlarini o‘rnatishda noaniqlik keltirmaydi, biroq ikkinchi darajali (O_2) ta’sir ko‘rsatuvchi omillar marshrut tezliklarini bajarilish darajasiga ta’sir ko‘rsatadi (3-rasm).

4. Xulosa

Temir yo‘l uchastka va yo‘nalishlari bo‘yicha poyezdlar harkat tezliklariga ta’sir ko‘rsatuvchi omillar asosan peregon, texnik va oraliq stansiyalarda poyezdlar bilan bajariladigan texnologik amallarga bog‘liq. Yuk poyezdlari harakat tezliklariga sarflanadigan vaqtlarni aniqlash va ularni me’yorlash bo‘yicha ko‘plab ilmiy tadqiqot ishlari olib borilishiga qaramay turli xil parametrlardan foydalanilgan. Poyezdlar harakat tezliklariga ta’sir ko‘rsatuvchi omillarni aniqlashda peregon, texnik va oraliq stansiyalardagi parametrlar asos qilib olindi.

Temir yo‘l uchastka va yo‘nalishlari bo‘yicha yuk poyezdlarining uchastka hamda marshrut tezliklariga 1-darajali va 2-darajali ta’sir ko‘rsatuvchi omillar parametrlari o‘rnatilgan vaqt me’yorlarining ortishi bilan PHG asosiy ko‘rsatkichlari o‘zgarishiga olib keladi. Yuk poyezdlari uchastka va marshrut tezliklariga ta’sir ko‘rsatuvchi 3-darajali tasodifiy omillarni aniqlash va ularni tizimlashtirish asosida texnologik jarayonlari uchun alohida tadqiqot ishlarini olib borish kerak.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Butunov Dilmurod Baxodirovich	Toshkent davlat transport universiteti “Temir yo‘ldan foydalanish ishlarini boshqarish” kafedrasi professori. t.f.f.d (PhD), E-mail: dilmurodpgups@mail.ru Tel.: +99897 2675567 https://orcid.org/0009-0009-4165-0257
Abduqodirov Sardor Asqar o‘g‘li	Toshkent davlat transport universiteti “Temir yo‘ldan foydalanish ishlarini boshqarish” kafedrasi dotsenti. t.f.f.d (PhD). E-mail: sardor_abduqodirov@bk.ru Tel.: +99897 7342992 https://orcid.org/0000-0001-9457-255X

Development and research of complex modified concretes of a new generation for non-heating and low-temperature technologies based on local raw materials

A.I. Adylkhodjaev[1][a], I.A. Kadyrov[1][b], B.Sh. Kudratov[1][c], D.T. Azimov[1][d]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: The article presents the results of the development and research of complex modified concretes of a new generation intended for use in heat-free and low-heat technologies based on local raw materials. Approaches to the modification of concrete mixtures in order to increase their thermal stability and accelerate the strength gain at low temperatures are considered. The analysis of the effectiveness of the use of various additives, as well as the effect of the composition of concretes on their physical, mechanical and operational characteristics is carried out. Special attention is paid to the use of local mineral components to improve the environmental and economic efficiency of construction.

Keywords: complex modified concrete, non-heating technology, low-temperature technology, local raw materials, multifunctional additive, mineral filler, modification of concrete mixtures, ecology of construction

1. Introduction

In the world, in terms of production volume and level of technical and economic indicators, concrete and reinforced concrete structures are recognized as the most popular materials among construction products. Concrete, which is called the "material of the 20th century", remains the main construction material in the 21st century. Modern requirements for the quality of construction indicate the need to use building materials with a relatively low cost, low production costs, superior in operational properties to existing analogues.

In recent years, the global construction industry has paid special attention to the development of low-energy technology for "concrete of the future" based on complex modifiers. Such an innovative approach provides a solution to urgent problems, such as environmental safety, economic efficiency and rational use of resources, and the implementation of such an approach allows for a significant increase in the strength of concrete - up to 70% or more - at early stages of hardening. New promising solutions - the use of complex modifiers based on polyfunctional additives and mineral modifiers, open up opportunities for the transition to resource-saving low-heating and non-heating technologies for the production of reinforced concrete products and structures, contributing to the acceleration of construction processes and ensuring the production of cement composites with predetermined properties that meet modern requirements for strength, durability and environmental sustainability.

In the Republic of Uzbekistan, in the rapidly developing construction industry, significant results have been achieved in the production of complex-modified concrete and reinforced concrete structures based on highly effective additives. This has reduced their cost, as well as improved the quality and performance properties of cement concrete. As an alternative, the use of complex additives has become more effective. Numerous studies have been conducted to improve the reliability and durability of building materials, which helps to increase the service life of structures and reduce operating costs. Practical recommendations are being developed to significantly improve the physical, mechanical and operational performance of such materials. One of the key aspects in implementing these tasks is the development and improvement of existing technologies for production using resource-saving low-heating or no-heating methods to ensure the required grade strength of finished products and structures with improved performance properties. This is achieved through the combined use of mineral microfillers of technogenic origin and polyfunctional chemical additives.

This article is devoted to the study of the development and study of complex-modified concretes of a new generation, intended for use in non-heating and low-heating technologies using local raw materials.

2. Materials and methods

In the article, Portland cement CEMI 32.5N from the Akhangarancement plant was used as a binder, steelmaking waste from the Foundry and Mechanical Plant of JSC Uzbek Railways was used as a fine filler, and a new generation of highly effective superplasticizer based on polycarboxylate esters and ammonia water POLIMIXJBI and superplasticizer based on polycarboxylate esters POLIMIX from ARMENT CONSTRUCTION CHEMICALS were used as a chemical additive.

The pH environment of hydrating cement suspensions with and without mineral additives was assessed using a pH meter. Both standard and modified concrete mixtures with various additives were used to study the kinetics of temperature changes during hydration of cement systems. The temperature measurement process was carried out using the calorimetry method with isothermal and adiabatic control of hardening conditions.

[a] https://orcid.org/0000-0001-5729-5178
[b] https://orcid.org/0000-0003-3924-0864
[c] https://orcid.org/0000-0003-2603-1334
[d] https://orcid.org/0000-0002-2015-9663

The plastic strength was studied on cement paste samples during the first hours after mixing. Penetrometric tests were used for this purpose using an automatic cone penetrometer, which records the resistance to cone penetration into the dough. Measurements were taken at 10-minute time intervals. This approach allowed us to obtain data on the rate of increase in plastic strength depending on the composition of the cement mixture.

Standard compression testing methods were used to study the kinetics of cement stone strength gain. Test samples were prepared from cement pastes with various additives and modifiers, which were formed into special forms and maintained under standard hardening conditions (20°C, humidity 95%). Strength tests were conducted at different stages of hydration: after 1, 3, 7, 28, 90 days.

3. Results and discussions

The alkalinity of the pore fluid of concrete is an important factor for preventing corrosion of steel reinforcement in reinforced concrete structures. To ensure the durability of the reinforcement, the minimum alkalinity level, expressed through pH, should not be lower than 11.8, according to most scientific studies. The introduction of amorphous silicon into the cement structure can facilitate the binding of calcium hydroxide ($Ca(OH)_2$) and, due to the transition to high-strength calcium hydrosilicates, provide a significant decrease in the alkalinity of the system. To test this hypothesis, we conducted additional studies of the effect of SLW on changes in the alkaline environment in cement.

Based on the literature review, the composition of modified cement stone using Novoangren fly ash (FA) was compared to evaluate the efficiency of SLW in the cement system. In the development of compositions, based on previous experiments, FA was adopted in the amount of 30% of the cement weight. The following compositions were used in the studies: 1. Reference composition of pure Portland cement (PC); 2. PC + FA (30%); 3. PC + SLW (25%); 4. PC + POLIMIX; 5. PC + POLIMIXJBI; 6. PC + POLIMIX + SLW (25%); 7. PC + POLIMIXJBI + SLW (25%); 8. PC + POLIMIXJBI + FA (30%). The results are presented in Table 1.

Table 1

pH values of the studied compositions

Time	Compound №1	Compound №2	Compound в №3	Compound в №4	Compound №5	Compound №6	Compound №7	Compound №8
10 min	12,41	12,31	12,34	12,31	12,31	12,31	12,31	12,31
20 min	12,41	12,31	12,34	12,41	12,31	12,31	12,31	12,31
30 min	12,56	12,42	12,45	12,56	12,44	12,42	12,41	12,34
40 min	12,56	12,42	12,45	12,56	12,44	12,42	12,41	12,34
60 min	12,74	12,42	12,45	12,56	12,44	12,42	12,41	12,34
1 day	12,74	12,42	12,65	12,74	12,72	12,66	12,66	12,65
10 day	12,71	12,42	12,65	12,74	12,72	12,66	12,66	12,65
20 day	12,71	12,02	12,65	12,72	12,7	12,66	12,64	12,2
30 day	12,71	11,98	12,1	12,71	12,68	12,64	12,62	12,1
60 day	12,71	10,8	12,1	12,71	12,68	12,64	12,62	11,6

As can be seen from the data in Table 1, the polyfunctional chemical additive and the mineral modifier from the SLW do not lead to a critical decrease in the pH value, which, accordingly, does not have a significant effect on the corrosion of steel reinforcement. However, the use of the ZU both independently and in combination with the polyfunctional additive does not achieve the required pH level of the pore fluid. Therefore, when using this type of mineral additive, it is necessary to take additional measures to protect the reinforcement.

To achieve the objectives of the study of the transition to resource-saving low-heating and non-heating technologies, it is necessary to evaluate the effect of a multifunctional additive (PFA) and steelmaking waste (SW) on the exothermy of cement (heat release). The use of exothermic heating allows for a significant reduction in energy costs when accelerating the hardening of concrete both in the production of prefabricated products and in monolithic construction (Fig. 5).

In our case, it is advisable to compare the effect of various modified cement compositions on the exothermy of the cement composite. The following compositions were used in the studies: 1. Reference composition of PC; 2. PC + POLIMIX; 3. PC + POLIMIXJBI; 4. PC + POLIMIX + SLW (25%); 5. PC + POLIMIXJBI + SLW (25%).

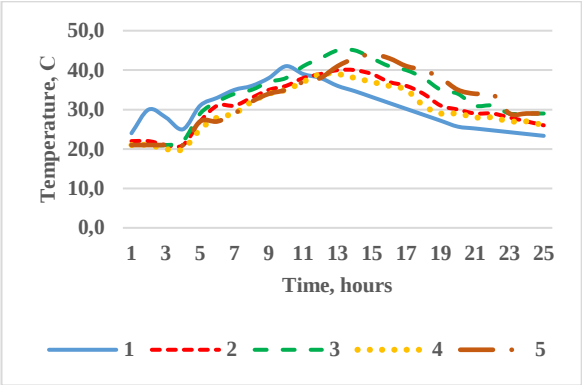

Fig. 5. Kinetics of temperature change of the studied compositions (1-standard; 2-PC+POLIMIX; 3-PC+POLIMIXJBI; 4-PC+POLIMIX+SLW (25%); 5-PC+POLIMIXJBI+SLW (25%))

Analysis of the data in Fig. 5 shows that chemical additives (superplasticizer and polyfunctional additive) significantly slow down the process of cement hydration at the initial stage. This is due to the fact that the additive molecules partially "block" the surfaces of the binder particles and prevent their reaction with water. Comparison of temperature dependencies during the hardening of compositions with NFA and SLW revealed that the exothermy of the modified cement composite increased by 4°C compared to the 1st and 2nd compositions and by 9°C compared to the 4th composition. This is explained by the fact that the ammonia additive in the NFA composition increases the solubility of the cement particles, which leads to an increase in temperature.

The crystal-coagulation period of cement binder structure formation is the phase of initial formation and development of the crystalline structure of cement stone, which begins after mixing with water and continues until a stable crystalline matrix is formed. At this stage, the water phase is saturated and calcium hydrosilicate crystals (C-S-H) are formed, as well as the particles are coagulated, which helps to strengthen and stabilize the cement stone. This period is critical for the formation of a strong structure of the cement binder and its physical and mechanical properties. The influence of additives and modifiers can significantly change the speed and quality of structure formation, which affects the performance characteristics of the material.

To study the duration of these processes, an assessment was made of the plastic strength of the cement system with various additives and its individual components, as well as their influence on the kinetics of plastic strength growth (Fig. 6) and the change in strength over time (Fig. 7). The plastic strength was assessed based on the ultimate shear stress measured during cone immersion.

The following compositions were used in the studies: 1. Reference composition of PC; 2. PC + POLIMIX; 3. PC + POLIMIXJBI; 4. PC + POLIMIX + SLW (25%); 5. PC + POLIMIXJBI + SLW (25%).

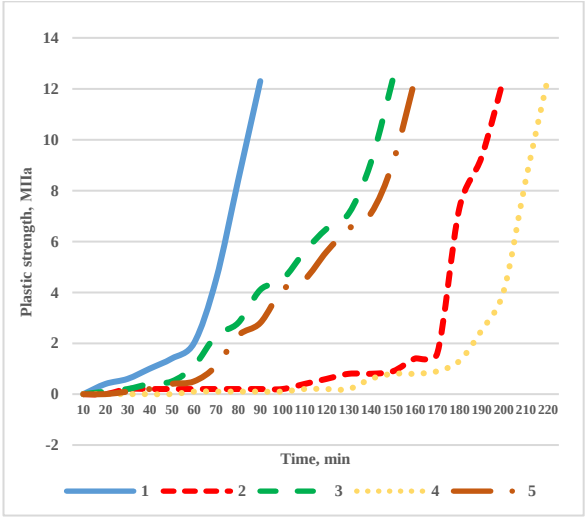

Fig. 6. Kinetics of increase in plastic strength of the studied compositions (1-standard; 2-PC+POLIMIX; 3-PC+POLIMIXJBI; 4-C+POLIMIX+SLW (25%); 5-PC+POLIMIXJBI+SLW (25%))

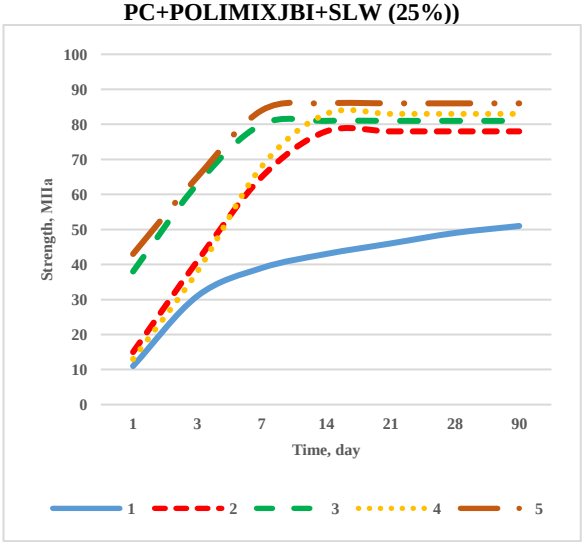

Fig. 7. Kinetics of compressive strength of the studied compositions (1-standard; 2-PC+POLIMIX; 3-PC+POLIMIXJBI; 4-C+POLIMIX+SLW (25%); 5-PC+POLIMIXJBI+SLW (25%))

The data in Fig. 6 show that induction hardening using the POLIMIX superplasticizer (compositions No. 2 and No. 4) increases the cycle time by 160-190 minutes. This is due to the formation of a film on the surface of the cement particles, which temporarily limits water adsorption and slows down hydrolysis. Over time, the film dissolves due to increased alkalinity and the intensive stage of structure formation of the system begins. In compositions No. 3 and No. 5, acceleration of the hardening process is observed. The use of NFA reduces the induction period from 160 to 60 minutes compared to composition No. 2. NFA accelerates hardening due to the activation of the reaction between cement and water, where the modifiers act as catalysts, accelerating the formation of hydrates.

Analysis of Fig. 7 shows that the POLIMIX superplasticizer slows down the growth of cement stone strength at the initial stage of hardening, but accelerates it in subsequent periods due to high water reduction. The introduction of NFA and SLW increases strength compared

to the reference composition by 59-61% in the initial period, and compared to compositions No. 2 and No. 4 - by 8-10%. Modified compositions with NFA demonstrate the highest strength indicators both on the 1st and 28th day, which is important for the technology of low-heating and non-heating concrete.

4. Conclusion

The conducted studies have shown that the use of complex additives based on NFA and SLW in cement systems does not lead to a significant decrease in the pH level, which allows for reliable protection of reinforcement from corrosion throughout the entire observation period. A slight decrease in pH by 0.2% in the control composition to a level of 12.68 indicates the preservation of a favorable alkaline environment for the passivation of reinforcement steel.

Analysis of the exothermic kinetics of hydration processes showed that the addition of ammonia accelerates cement hardening and increases the peak temperature by 4°C compared to reference samples. This confirms the possibility of using the proposed composition for concrete production technologies for non-heating or low-heating technologies.

In addition, the obtained data confirm that the use of complex additives based on NFA and SLW allows achieving the strength of cement stone up to 87 MPa due to the improvement of its microstructure and acceleration of hydration processes. These results can serve as a basis for further improvement of low-heating and non-heating concreting technologies using local raw materials.

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Information about the authors

Adilxodjayev Anvar Ishanovich	Toshkent davlat transport universiteti “Bino va sanoat inshootlari qurilishi” kafedrasi professori t.f.d., E-mail: anvar_1950@mail.ru Tel.:+9989339831926 https://orcid.org/0000-0001-5729-5178
Kadirov Ilhom Abdullayevich	Toshkent davlat transport universiteti “Bino va sanoat inshootlari qurilishi” kafedrasi dotsent PhD, E-mail: ilhom.kadirov.1990@mail.ru Tel.:+9989973306119 https://orcid.org/0000-0003-3924-0864
Kudratov Bekzod Sherzodovich	Toshkent davlat transport universiteti “Bino va sanoat inshootlari qurilishi” kafedrasi tayanch doktoranti, E-mail: kudratov_bekzod@mail.ru Tel.:+998933983047 https://orcid.org/0000-0003-2603-1334
Azimov Doniyor To‘ychi o‘g‘li	Toshkent davlat transport universiteti “Bino va sanoat inshootlari qurilishi” kafedrasi dotsent PhD, E-mail: Stalker.d12@gmail.com Tel.:+998974209688 https://orcid.org/0000-0002-2015-9663

Study of the effect on the amount of cargo flow between Uzbekistan and Kyrgyzstan by the method of multiple regression

I. Khurramov[1][a] , X. Umarov[1][b], J. Azimov[1][c]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: The main goal of the work is to identify the factors affecting the speed of freight trains and systematize them. Factors affecting the established technical standards of freight train movement speed on railway sections and routes were analytically analyzed and their impact levels on the performance of the main indicators of the train movement schedule were determined. As a result, the "Ishikawa" scheme for determining the factors affecting the speed of freight trains was developed. The random factors affecting the speed of freight trains on the section and route were classified in terms of levels and tasks of their systematization were proposed.

Keywords: Railway section and route, section speed, route speed, train movement schedule, factor, station

O‘zbekiston va Qirg‘iziston o‘rtasidagi yuk oqimi miqdoriga ko‘p regressiya usuli bilan ta’sirini o‘rganish

Khurramov I.[1][a], Umarov X.[1][b], Azimov J.[1][c]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Ishdan asosiy maqsad yuk poyezdlari harakat tezliklariga ta’sir ko‘rsatuvchi omillarni aniqlash va ularni tizimlashtirishdan iborat. Temir yo‘l uchastka va yo‘nalishlari bo‘yicha yuk poyezdlari harakat tezliklarining o‘rnatilgan texnik me’yorlariga ta’sir ko‘rsatuvchi omillar analitik tahlil qilindi hamda ularning poyezdlar harakati grafigi asosiy ko‘rsatkichlari bajarilishiga ta’sir darajalari aniqlandi. Natijada yuk poyezdlari harakat tezliklariga ta’sir ko‘rsatuvchi omillarini aniqlashning “Isikava” sxemasi ishlab chiqildi. Yuk poyezdlari uchastka va marshrut tezliklariga ta’sir ko‘rsatuvchi tasodifiy omillar darajalar kesimida tasniflandi va ularni tizimlashtirish vazifalari taklif etilgan.

Kalit so‘zlar: Temir yo‘l uchastkasi va yo‘nalishi, uchastka tezligi, marshrut tezlik, poyezdlar harakati grafigi, omil, stansiya

1. Kirish

Mamlakatimiz uchun transport koridorlarini rivojlantirish, jahon bozorlariga tez va erkin chiqish juda muhim shu bois transport koridorlarni rivojlantirish mamlakatimiz uchun muhim ahamiyat kasb etadi.

Transport davlatning ishlab chiqarish infratuzilmasining eng muhim elementi bo’lib, milliy va jahon iqtisodiyotining rivojlanishini ta’minlaydi va ijtimoiy ishlab chiqarishning real sektorini boshqarish sub’ektlarining rolini kuchaytirishning zamonaviy tendentsiyalarini aks ettiradi.

Ushbu strategiyada noaniqlik va xavf ostida yuk aylanishini prognoz qilish muhim rol o’ynaydi. Adabiyotlarni tahlil qilish shuni ko’rsatadiki [1,2,5,6], transport oqimining prognozini modellashtirish uchun asosan ikkita usul qo’llaniladi – korrelyatsion-regressiya tahlili va prognozli ekstrapolyatsiya usuli.

Birinchi usul korrelyatsion-regressiya tahlili korrelyatsion va regressiya tahlili usullari yoki omillarga bog’liqlikni o’rganishning boshqa statistik usullari bilan omillarni o’zgarish dinamikasi sabab-ta’sir mexanizmini rasmiylashtiradigan matematik modelni shakllantirishni nazarda tutadi. Birinchi usulni barqaror iqtisodiy sharoitlarda va transport oqimini qisqa muddatli prognozlashda qo’llash maqsadga muvofiqdir [7,8].

2. Tadqiqot metodikasi

Biz matematik model tuzish maqsadida iqtisodiy ko‘rsatkichlarning O‘zbekiston va Qirg‘iziston o‘rtasidagi yuk oqimi miqdoriga ko‘p regressiya usuli bilan ta’sirini o‘rganamiz.

3. Natija va muhokamalar

O‘zbekiston va Qirg‘iziston o‘rtasidagi yuk oqimini regressiya tahlili uchun quyidagi omillar ko‘rib chiqildi

[a] https://orcid.org/0000-0001-7747-9863
[b] https://orcid.org/0000-0003-0397-2780
[c] https://orcid.org/0000-0002-0859-3184

[3,4]:

- O‘zbekiston YAIM qiymati omili – X_1;
- Qirg‘iziston YAIM qiymati omili – X_2;
- O‘zbekiston va Qirg‘iziston o‘rtasidagi yuk oqimi ko‘rsatkichi - Y_t

O‘zbekiston va Qirg‘iziston o‘rtasidagi yuk oqimi ko‘rsatkichiga X_1, X_2, omillarining ta’sirini o’rganish va ular orasidagi korrellatsion bog’lanishni tahlil qilish, hamda regression modellar qurish masalasini ko’rib chiqamiz.

X_1, X_2 ta’sir omillarini ko‘rib chiqilayotgan statistik ma’lumotlari o‘rtasidaga bog‘liqlik mavjudligini miqdoriy baholash va tanlab olingan omillar yuk oqimiga bog‘liqligini sonli ko‘rsatkich bilan aniqlash imkonini beradi. Bu quyidagi formula orqali aniqlanadi:

$$r_{xy} = \frac{\sum(x_i - \bar{x}) \cdot (y_{1_i} - y_1)}{\sqrt{\sum(x_i - x)^2 \cdot \sum(y_{1_i} - \bar{y}_1)^2}}. \qquad (1.1)$$

bu yerda: X namunasida olingan qiymatlar;
y_1 - X uchun o‘rtacha qiymat;
$\bar{x}$ – X uchun o‘rtacha qiymat;
$\bar{y}_1$ – Y uchun o‘rtacha qiymat.

Buning uchun dastlab yuqoridagi ko’rsatkichlarning korrellatsiya koeffisentlarini hisoblaymiz. Regressiya tahlili uchun yillar bo‘yicha omillar statistikasi 1.1-jadvalda keltirilgan.

1.1-jadval

Regressiya tahlili uchun yillar bo‘yicha omillar statistikasi

№	Yil	X_1, mlrd. doll. AQSH	X_2, mlrd. doll. AQSH	Y_t - O‘zbekiston va Qirg‘iziston o‘rtasida yuk oqimi, mln. ton.
1	2017	62,08	7.70	0.8
2	2018	52.87	8.27	1.2
3	2019	60.28	9.37	1.3
4	2020	60.22	8.27	1.2
6	2021	69.6	9.24	1.6
7	2022	80.39	11.54	2.0
8	2023	90.9	13.7	1.4

O‘zbekiston va Qirg‘iziston o‘rtasidagi yuk oqimi ko‘rsatkich Y_t va X_1 omil uchun korrelyatsiya koeffitsienti $r_{xy1} = 0.828$ huddi shunday Y_t va X_2 uchun korrelyatsiya koeffitsienti $r_{xy2} = 0.863$ aniqlandi. Olingan korrelyatsiya taxlillari natijalarni olib shuni xulosa qilash mumkinki O‘zbekiston va Qirg‘iziston o‘rtasidagi yuk usish hajmi O‘zbekiston va Qirg‘iziston yalpi ichki maxsulotining o‘sish ko‘rsatkichlariga bog‘liq.

O‘zbekiston va Qirg‘iziston o‘rtasidagi yuk oqimining ko‘p omilli regressiyasining umumiy tenglamasi quyidagicha:

$$Y_t = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_t. \qquad (1.1)$$

bu yerda α_0, α_1, α_2 va – regressiya koeffitsientlari.

Tenglamaning noma’lum koeffitsientlarini matritsa usuli bilan aniqlaymiz:

$$A = (X^T \cdot X)^{-1} \cdot X^T \cdot Y_t, \qquad (1.2)$$

bu yerda A – regressiya tenglamasi koeffitsientlarining ustun vektori;
X^T – transpozitsiyalangan matritsasi;
X – n - qatorlar va (k) X_1, X_2, ta’sir qiluvchi ma’lum omillar ustunlarining o‘lchamlari matritsasi;
Y_t o‘lchovli kuzatuvlar vektori – ustuni (bu yerda n = 7 ga teng kuzatuvlar soni; k - 2 ga teng ta’sir qiluvchi omillar soni).

Matritsalarni tuzamiz.

$$X = \begin{Bmatrix} 1 & 62.08 & 7.70 \\ 1 & 52.87 & 8.27 \\ 1 & 60.28 & 9.37 \\ 1 & 60.22 & 8.27 \\ 1 & 69.60 & 9.24 \\ 1 & 80.39 & 11.54 \\ 1 & 90.9 & 13.7 \end{Bmatrix}; \; Y_t = \begin{Bmatrix} 0.8 \\ 1.2 \\ 1.3 \\ 1.2 \\ 1.6 \\ 2.0 \\ 1.4 \end{Bmatrix}$$

Keyin transpozitsiyalangan matritsani tuzamiz:

$$X^T = \begin{Bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 62.08 & 52.87 & 60.28 & 60.22 & 69.60 & 80.39 & 90.9 \\ 7.70 & 8.27 & 9.37 & 8.27 & 9.24 & 11.54 & 13.7 \end{Bmatrix}$$

E’tibor bering, $|X^T \cdot X|$ matritsaning determinanti $1{,}031 \cdot 10^{21}$ ga teng, ya’ni matritsa ($X^T \cdot X$) xato emas.

A matritsa elementlarining hisoblangan qiymatlaridan foydalanib, biz regressiya tenglamasini yozamiz:

$$Y_t = 2.77 + 0.0526 \cdot X_1 + 2.17 \cdot X_2 \qquad (1.3)$$

Olingan regressiya tenglamasining ahamiyatli ekanligini Fisherning F mezoniga (F - mezon) muvofiq tekshiramiz. Buning uchun regressiya teglamasi ahamiyatsiz, ya’ni barcha koeffetsiyentlar nolga tengligi haqidagi H_0 gipoteza tekshiriladi. Quyidagi mezonni kiritamiz:

$$F_{his} = \frac{\frac{1}{k} \cdot Q_R}{\frac{1}{n-k-1} \cdot Q_{\text{ост}}}. \qquad (1.4)$$

H_0 gipotezani tekshirish uchun (1.4) statistik mezondan foydalanamiz, ma'lumki bu tasodifiy miqdor erkinlik darajasi (k) va (n – k-1) bo’lgan F taqsimotiga ega.
Bu yerda
k – omillar soni, bizning holda 2 ga teng;
Q_R - og‘ish kvadratlarining yig‘indisi;
n – kuzatuvlar soni;
Q_{ost} - kuzatuv natijalarining og‘ish kvadratlari yig‘indisi.

$$Q_R = \sum_{i=1}^{n} (Y_t)^2, \qquad (1.5)$$

$$Q_{ost} = \sum_{i=1}^{n} (Y_t - \hat{Y}_t)^2. \qquad (1.6)$$

Fisher taqsimotining qiymatlar jadvalidan erkinlik darajasi (k) va (n – k-1) bo’lgan F_{krit} -qiymat topiladi. Gipotezani tekshirish qoidasiga ko’ra, agar $F_{his} > F_{krit}$ bo’lsa H_0 gepoteza rad etiladi. Aks holda H_0 gepotezani rad etishga asos yo’q deyiladi. Demak agar $F_{his} > F_{krit}$ tengsizlik o’rinli bo’lsa topilgan regressiya tenglamasi statistik ahamiyatli deyiladi, aks holda tenglama ahamiyatsiz bo’ladi. Agar regressiya tenglamasi ahamiyatsiz bo‘lsa, ya’ni tenglamaning barcha koeffitsientilari nolga

teng bo‘lsa, unda regressiya tenglamasini tahlil qilish mantiqiy emas. Regressiya tenglamasi uchun hisob-kitobni 1.2-jadvalga kiritamiz.

1.2-jadval

***F* - mezon bo‘yicha regressiya tenglamasining ahamiyatini tekshirish**

№	X_1	X_2	Y_t	$\hat{Y}_t$	$\hat{Y}_t^2$	$(Y_t - \hat{Y}_t)^2$
1	62.08	7.703	0.8	7.70	60.37	47.61
2	52.87	8.271	1.2	8.27	66.42	49.98
3	60.28	9.371	1.3	9.37	76.74	65.12
4	60.22	8.27	1.2	8.27	72.93	49.98
5	69.6	9.249	1.6	9.24	98.01	58.36
6	80.39	11.54	2.0	11.54	128.37	91.01
7	90.9	13.7	1.4	13.7	111.94	151.29
Q_R= 614.78		Q_{ost}= 513.35				

Ahamiyatlilik darajasida 0,05 bo‘lganda *F* – mezon bo‘yicha regressiya tenglamasining ahamiyatini, ya’ni nol gipotezani ushbu ifoda bo‘yicha tekshiramiz.

$$F_{his} = \frac{\frac{1}{2} \cdot 614.78}{\frac{1}{7-2-1} \cdot 513.35} = 22.71$$

F - taqsimot jadvaliga ko‘ra 0,05 ahamiyatlilik darajasi va 3 va 4 erkinlik darajalari uchun biz kritik qiymatni topamiz: F_{krit} (0.05; 3; 4)= 6.59 ga teng. Yuqorida takidlaganligidek $F_{his} > F_{krit}$ bo‘lganligi sababli H_0 gipotezasi rad etiladi. Olingan regressiya tenglamasi ahamiyatga ega.

Topilgan regressiya tenglamasini omillari oldiga koeffitsientlarining statistik ahamiyatli ekanligini tekshirish uchun Stuyudentning *t* testidan foydalanamiz.

t -mezonga ko'ra, ko'rsatkichlarning tasodifiy tabiati, ya'ni ularning noldan ahamiyatsiz farqi to'g'risida H_0 gipotezasi ilgari suriladi. Keyinchalik, baholangan $t_{факт}$ korrelyatsiya koeffitsienti uchun r_{xy} mezonining haqiqiy qiymatlari ularning qiymatlarini standart xato qiymatiga moslashtirish orqali hisoblanadi.

$$t_b = \frac{b}{m_b}; \quad t_a = \frac{a}{m_a}; \quad t_r = \frac{r_{xy}}{m_{r_{xy}}}.$$

Chiziqli regressiya va korrelyatsiya koeffitsienti parametrlarining standart xatolari quyidagi formulalar bilan aniqlanadi:

$$m_b = \sqrt{\frac{\sum(y-\hat{y}_x)^2/(n-2)}{\sum(x-\bar{x})^2}} = \sqrt{\frac{S_{ocm}^2}{\sum(x-\bar{x})^2}} = \frac{S_{ocm}}{\sigma_x\sqrt{n}};$$

$$m_a = \sqrt{\frac{\sum(y-\hat{y}_x)^2}{(n-2)} \cdot \frac{\sum x^2}{n\sum(x-\bar{x})^2}} = \sqrt{S_{ocm}^2 \frac{\sum x^2}{n^2\sigma_x^2}} = S_{ocm}\frac{\sqrt{\sum x^2}}{n\sigma_x};$$

$$m_{r_{xy}} = \sqrt{\frac{1-r_{xy}^2}{n-2}}.$$

Styudentning t –statistikasining haqiqiy va kritik (jadval) qiymatlarini taqqoslash natijasida, ya’ni t_{kr} va t_{his} qiymatlarni taqqoslab H_0 gipotezasini qabul qilanadi yoki rad etiladi.

t_{kr} - qiymat berilgan erkinlik darajasi $k = n-2$ da *va* ahamiyatlilik darajasi $\propto da$ tasodifiy omillar ta'sirida mezonning mumkin bo’lgan eng katta qiymati.

Fisherning *F* -mezoni ($k = 1; m = 1$) va *t* – Styudent mezoni o’rtasidagi bog’liqlik quyidagi tenglama bilan ifodalanadi:

$t_r^2 = t_b^2 = t_r^2 = \sqrt{F}$.

Agar $t_{табл} < t_{факт}$ bo'lsa, u holda H_0 rad etiladi, ya'ni a, b va r_{xy} koeffitsientilarni noldan farq qilishi tasodifiy emas va omillarni tizimli ta'siri ostida hosil bo'ladi. Agar $t_{табл} > t_{факт}$ bo'lsa, H_0 gipoteza rad etilmaydi va a, b yoki r_{xy} koeffitsientilar tasodifiy xarakterga ega.

4. Xulosa

Xulosa qilib aytganda, O‘zbekiston va Qirg‘iziston o‘rtasidagi yuk oqimi yildan yilga oshib bormoqda va bog’liklik borligi va ma’lumotlar ishonchliligi namoyon bo’ldi. O‘zbekiston va Markaziy Osiyo davlatlari bilan ham o‘rtasidagi yuk oqimi modellarini ishlab chiqish zarur.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Xurramov Islom Ravshan o‘g‘li	Doktorant, Toshkent davlat transport universiteti, Temir yo‘l muhandisligi kafedrasi. E-mail: xurramovislom219@gmail.com Tel.:+998903497533 https://orcid.org/0000-0001-7747-9863
Umarov Xasan Kobilovich	PhD, dotsent, Toshkent davlat transport universiteti, Temir yo‘l muhandisligi kafedrasi. E-mail: janobhuk@mail.ru Tel.:+998904434914 https://orcid.org/0000-0003-0397-2780
Azimov Jaxongir Baxramovich	PhD, dotsent, Toshkent davlat transport universiteti, Oliy matematika kafedrasi. E-mail: azimovjb@gmail.com Tel.:+998977441564 https://orcid.org/0000-0002-0859-3184

Study of the influence of modifier on the physical and mechanical properties of sulfur composite material

U.A. Ziyamukhamedova[1][a], F.N. Nurqulov [2][b], A.B. Djumabaev[1][c] , J.H. Nafasov[1][d], E.T. Turgunaliev[1][e] , M.U. Rustamov[3][f]

[1]Tashkent state transport university, Tashkent, Uzbekistan
[2]Tashkent Scientific Research Institute of Chemical Technology, Tashkent, Uzbekistan
[3]Worker at "Industrial Energy Group" LLC, Mubarak, Uzbekistan

Abstract: This article discusses the improvement of the physical, mechanical and operational properties of composite materials modified with sulfur binder plasticizers used in the modern construction industry. The influence of plasticizers on the fire-resistant properties of composite materials has also been studied. In addition, based on an in-depth analysis of the literature, the importance of the type and size of fillers and their mixing technology in the formation of a structure with low porosity of a sulfur-binding composite material was studied. The article discusses in detail the method of obtaining a stable sulfur-binding composite material, preparing a solid filler, soaking the filler in an organic modifier, wetting and heating the filler with the modifier, mixing it with elemental sulfur and cooling. with the formation of a solid product.

Keywords: Sulfur concrete, modification, fiberglass, flint, dispersed aggregate, mechanical properties, flammability, thermal conductivity

Modifikatorning oltingugurt kompozit materialning fizik-mexanik xususiyatlariga ta'sirini o'rganish

Ziyamuxamedova U.A.[1][a], Nurqulov F.N. [2][b], Djumabayev A.B. [1][c], Nafasov J.H.[1][d], Turg'unaliyev E.T.[1][e], Rustamov M.U.[3][f]

[1]Toshkent davlat transport universiteti, Toshkent, O'zbekiston
[2]Toshkent kimyo-texnologiya ilmiy tadqiqot instituti, Toshkent, O'zbekiston
[3]Sanoat Energetika Guruhi MChJ XK Muborak XIChK, Muborak, O'zbekiston

Annotatsiya: Ushbu maqolada zamonaviy qurilish sanoatida foydalaniladigan oltingugurt bog'lovchili plastifikatorlar bilan modifikasiyalangan kompozit materiallarning fizik, mexanik va ekspluatasion xaossalarini yaxshilash haqida so'z boradi. Shuningdek plastifikatorlarning kompozit materiallarning olovbardoshlik xossalariga ta'siri tadqiq qilingan. Bundan tashqari adabiyotlarning chuqur tahlili asosida oltingugurt bog'lovchili kompozision materialning g'ovakliklari kam bo'lgan struktura xosil qilishda to'ldiruvchilarning turi, o'lchamlari va ularni aralashtirish texnalogiyasining axamiyati o'rganilgan. Maqolada barqaror oltingugurt bog'lovchili kompozision material olish usuli qattiq to'ldiruvchini tayyorlash, to'ldiruvchini organik modifikatorga shimdirish, modifikator bilan to'ldiruvchini namlash va qizdirish, uni oltingugurt elementi bilan aralashtirish va qattiq mahsulot shakllanishi uchun sovutish jarayonlari mukammal yoritilgan.

Kalit so'zlar: Oltingugurt beton, modifikatsiyalash, shisha tola, chaqiqtosh, dispers to'ldiruvchi, mexanik xossa, yonuvchanlik, issiqlik o'tkazuvchanlik

1. Kirish

Texnologiyaning rivojlanishi bilan kamchiliklarning aksariyati yo'q qilindi. Shunday qilib, oltingugurtli bog'lovchi plastifikatorlar (xususan, polisudfidlar) qo'shilishi nafaqat qotishmaning plastik xususiyatlarini oshirishga, balki yoriqlarni kamaytirishga yordam beradi va disiklopentadin shaklidagi qo'shimchalar ushbu qurilish materiallarining yong'inga bardoshliligini oshiradi [1-3].

[a] https://orcid.org/0000-0001-5005-0477
[b] https://orcid.org/0000-0002-6546-3431
[c] https://orcid.org/0000-0001-5005-0477
[d] https://orcid.org/0000-0002-0415-2584
[e] https://orcid.org/0000-0003-3257-5434
[f] https://orcid.org/0009-0008-1440-5988

Oltingugurt tarkibli betonlarning xossalari bu hozirgi vaqtda juda batafsil o‘rganilgan uning ichki tuzilishining natijasidir [4]. To‘ldiruvchi qo‘shilmasdan oltingugurt bir hil tuzilishga (gomogen) ega bo‘lgan modda bo‘lib, bu undagi molekulalarning bir-biriga nisbatan zich joylashishini anglatadi. To‘ldiruvchining mavjudligida oltingugurt molekulalari to‘ldiruvchi molekulalarini "biriktirib" o‘rganiladigan bog‘lovchini ichki bo‘shliqlarini shunday to‘ldiradiki undagi g‘ovaklik deyarli sezilmaydi (hatto mikroskop ostida ham). Oltingugurt tarkibli betonlardagi g‘ovaklikning kichikligi ko‘p jihatdan uni qo‘llanilish sohalariga bog‘liq [5]. Bu chiqindilarni saqlash, chiqindi suv kollektorlari va boshqa inshootlar uchun asosiy material sifatidagi oltingugurt tarkibli betondan foydalanish bilan bog‘liq.

Oltingugurtli beton ishlab chiqarishda asosiy texnologik parametr - bu oltingugurtli eritmaning qovushqoqligidir, chunki u mineral to‘ldiruvchilarni bir hil massa hosil qilish layoqiyati kabi texnologik xossalarni belgilaydi. Ma’lumki, kompozitsion qurilish materiallarida to‘ldiruvchi bog‘lovchi bilan takomillashgan solishtirma yuzasi xisobiga sezilarli darajadagi maydonda aloqaga kirishadi [6].

Bog‘lovchi va mineral to‘ldiruvchining o‘zaro ta’sirining birinchi bosqichida mineral to‘ldiruvchilar yuzasi va o‘ta mayda to‘ldiruvchilar yuzalarini namlash amalga oshiriladi. Shuning uchun, oltingugurtli betonlarni olishda asosiy struktura hosil qilish to‘ldiruvchini eritilgan oltingugurtni bilan aralashtirish bosqichida sodir bo‘ladi. Bunda oltingugurtni sovutish jarayonida mineral to‘ldiruvchi yuzasida bir hil kristallar hosil bo‘ladi, ularning o‘lchamlari to‘ldiruvchisiz oltingugurt miqdoridagiga nisbatan ancha past bo‘ladi [7]. Optimal darajada to‘ldirish darajasida deyarli barcha oltingugurt bir jinsli nozik kristalli holatga o‘tadi. Oltingugurt kristallarini kamayishi na nafaqat oltingugurtli bog‘lovchining mustahkamligini oshirishini belgilaydi. To‘ldiruvchi donalari atrofida optimal qalinlikdagi plyonka hosil bo‘ladi.

Saudiya Arabistonida oltingugurt-qum-bitum aralashmasidan yo‘l-qurilish ishlari uchun qo‘llaniladigan materiallar, ishchi kuchi va asbob-uskunalarning taxminiy xarajatlari bo‘yicha foydalanish an’anaviy asfaltbetonga nisbatan mablag‘larning 60 foiziga tejash imkonini berdi. Ba’zi Yevropa mamlakatlarida oltingugurtning narxi biroz yuqori bo‘lsada, yaxshi sifatga ega to‘ldiruvchilar mavjud bo‘lmagan joylarda oltingugurt-qum-bitum aralashmalaridan foydalanish o‘zining juda yaxshi samarasini beradi [8-9].

2. Tadqiqot metodikasi

Oltingugurt beton aralashmasini tayyorlash usulida 160 °C gacha oldindan qizdirilgan 10 mm qalinlikdagi chaqiqtosh, 3 mm yiriklikdagi qumdan iborat to‘ldiruvchilar aralashmasi qizdirilgan majburiy xarakatlanuvchi beton qorgichga solinadi, aralashtiriladi, 160 °C xaroratgacha qizdirilgan oltingugurt aralashmasi, yod modifikatori qo‘shiladi va aralashtiriladi, olingan qorishma shakllarga yoki beton joylagichga tushiriladi. Oltingugurt beton aralashmasining tarkibi og‘irligiga nisbatan quyidagicha bo‘ladi: bazalt chiqiti to‘ldiruvchisi chaqiqtosh 31,65-44,26+qum 24,07-33,64%. Ularni 1-2 daqiqa 160°S haroratda aralashtiriladi. Bog‘lovchi tarkibi oltingugurt 13,550-27,13, yod 0,005-0,01, to‘ldiruvchi - IES kuli 8,545-17,14. Bog‘lovchi va to‘ldiruvchi aralashmalari 160 °C haroratda 2-3 daqiqa aralashtiriladi.

Barqaror oltingugurt bog‘lovchili kompozitsion material olish usuli qattiq to‘ldiruvchini tayyorlash, to‘ldiruvchini organik modifikatorga shimdirish, modifikator bilan to‘ldiruvchini namlash va qizdirish, uni oltingugurt elementi bilan aralashtirish va qattiq mahsulot shakllanishi uchun sovutishni o‘z ichiga oladi [10-11]. Ixtiro barqaror va yuqori mustahkam oltingugurtli kompozit materiallarni olish imkonini beradi.

Barqaror oltingugurt bog‘lovchili kompozitsion material olish usuli quyidagi operatsiyalarni o‘z ichiga oladi:

- mineral to‘ldiruvchilar, zola, kremniy qumi, sanoat ishlab chiqarishning ikkinchi darajali maxsulotlari kombinatsiyasidan tashkil topgan guruxdagi qattiq to‘ldiruvchilarni tayyorlash;
- to‘ldiruvchini shimdirish maqsadida tayyorlangan gazoil va katalitik kreking qoldig‘i tarkibiga ega to‘q neft yog‘i bilan to‘ldiruvchini organik modifikatorga shimdirish;
- oltingugurt bilan to‘ldiruvchi yuzasini faollashtirish maqsadida modifikator bilan to‘ldiruvchini namlash va qizdirish;
- kukun shaklidagi maydalangan qattiq yoki erigan elementar oltingugurt modifikatorga shimdirilgan to‘ldiruvchiga qo‘shiladi;
- ixtiyoriy qattiq oltingugurt erish uchun yetarli darajada bo‘lgan haroratda modifikatorga shimdirilgan to‘ldiruvchini elementar oltingugurt bilan biriktirish uchun alashtiriladi;
- suyuq aralashma qattiq maxsulot shaklini olunga qadar sovutiladi.

Oltingugurtli betonni tayyorlash uchun texnik oltingugurt, oltingugurt birikmali chiqindilar ishlatilishi mumkin [12]. Inert to‘ldiruvchi va to‘ldirgichlar sifatida zich tog‘ jinslari, sun’iy va tabiiy g‘ovak materiallar, ishlab chiqarish chiqindilari (tog‘ va cho‘kindi jinslarning maydalanish donalari) ishlatiladi [13-14].

Oltingugurtli bog‘lovchilarni ishlab chiqarish texnologiyasi sement ishlab chiqarish texnologiyasiga qaraganda ancha sodda va arzon xisoblanadi. Oltingugurtli bog‘lovchilarni ishlab chiqarish texnologiyasi ishlab chiqarishni rivojlantirish natijalariga ko‘ra, sementli an’anaviy usullarga nisbatan quyidagi ko‘rsatkichlarga ega: energiya sarfi 1,5-2 baravar kamayadi; ishlab chiqarishning ekologik xavfsizligi oshiriladi; ishlab chiqarishni tashkil etish uchun kapital xarajatlar 40-50 % ga kamayadi; chiqindilarsiz ishlab chiqarishga erishiladi; tannarx 1,5-2 marotaba kamayadi;

- saqlash muddati sezilarli darajada oshiriladi (deyarli cheklovlarsiz).

3. Natija va muhokama

Oltingugurt tarkibli bog‘lovchilar asosidagi beton materiallarni yong‘inbardoshligi va xossalarni oshirish uchun polimer modifikatorlar taklif etilib ularni optimal sharoitlari hamda fizik-mexanik xususiyatlarni tadqiq etildi.

Ma’lumki, qurilish materiallari ishlab chiqarish sanoatida innovatsiyalarning qiymati va iqtisodiy samaradorligi bir vaqtning o‘zida ulardan foydalanish natijasida bir vaqtning o‘zida hal qilish mumkin bo‘lganda doimo ortadi [15]. Oltingugrt tarkibli bog‘lovchilar asosidagi betonlar o‘zining kichik suv shimuvchanligi va suv o‘tkazuvchanligi, kichik muddatlarda o‘z shaklini saqlashi va mustaxkamlikka erishishi, korroziyaga yuqori

chidamliligi bilan oddiy og‘ir betonladan ajralib turadi. Shu bilan birga oltingugrt tarkibli bog‘lovchilar asosidagi betonlarning ishlatiish jabxalarini cheklaydigan ma’lum salbiy xossalari mavjud bo‘lib bu ulardagi kichik xaroratga (140 ^{o}S), termik chidamliligi va ishlab chiqarishdagi yuqori zaharlilik xisoblanadi [16-19]. Oltingugrt tarkibli bog‘lovchilar asosidagi betonlaridagi asosiy kamchiliklarni bartaraf etish, ularning ishlatilish jabxalarini kengaytirish, ulardan konstruktiv materiallar olish maqsadida mualliflar tomonidan MB-100 markali modifikatorlar asosida olovbardosh oltingugurt tarkibli betonlar ishlab chiqildi (1 va 2 jadvallar).

Oltingugurt tarkibli bog‘lovchilar asosidagi betonlar tayyorlash texnologiyasi kuyidagicha amalga oshiriladi: yirikligi 4-5 mm bulgan kum, 10-50 mm yiriklikdagi chakiktosh, kerakli mikdordagi oltingugurt va MB-100 markali yonuvchanlik hamda mexanik xossalarni yaxshilovchi modifikatorlar mqo‘shilib 1130-170 ^{o}C xaroratda kizdiriladi va xona xaroratida sovutiladi [20-21]. Oltingugurt tarkibli bog‘lovchilar asosidagi tayyorlangan betonlarning tarkibi 1–jadvalda keltirilgan.

1–jadval

Modifikatsiyalangan oltingugurt asosidagi betonlarning optimal tarkibi

T.r	Tarkiblar	Namunalar tarkibi, %		
		Etalon	MB-100 markali modifikator asosidagi beton	An’anaviy modifikator asosidagi beton
1	Chakiktosh	40	35	35
2	Otingugurt	30	36	30
3	Kum	30	23	25
5	MB-100 markali modifikator	-	6	-
6	Pirilaks	-	-	10

2–jadval

MB-100 markali modifikator asosida tayyorlangan oltingugurt betonlarning xossalari

T.r	Kursatkichlar nomi	Etalon	MB-100 markali modifikator	Pirilaks asosidagi beton namunasi
1	Zichligi, kg/m^3	2200	2140	2200
2	Siqilishdagi mustaxkamlik darajasi, MPa	62	63	58
3	Egilishdagi mustaxkamlik darajasi, MPa	12	12	10
4	Mustaxkamlikni ta’minlash vakti, soat	1,1	1,1	1,1
5	Issiqlik o‘tkazuvchanlik koeffitsienti	0,08	0,08	0,08
6	Kimyoviy chidamlilik -kislota, ishkor va tuzlarga	85	85	85
7	Yonuvchanlik guruxi	III	II	II

Tanlanilgan tarkiblar buyicha MB-100 markali modifikator optimal mikdorini aniqlash bo‘yicha amaldagi me’yoriy xujjatlar talablari asosida ularning fizik-mexanik, kimyoviy va teplofizik xossalari aniqlanildi (2–jadval).

Oltingugurt tarkibli bog‘lovchilar asosidagi betonlarning amaldagi me’yoriy xujjatlar asosida fizik-mexanik, kimyoviy va teplofizik xossalari aniqlanildi (2–jadval). MB-100 markali modifikator yonuvchanlik darajasini pasaytiruvchi tarkiblar asosida tayyorlangan oltingugurt tarkibli bog‘lovchilar asosidagi betonlarning zichligi tarkibga ma’lum mikdorda kushimchalar kiritilishi xisobiga taxminan 1,5-2% ga kamayishiga erishildi.

MB-100 markali modifikator markali yonuvchanlikni kamaytiruvchi qo‘shimchalar asosidagi oltingugurt tarkibli betonlarni kimyoviy chidamlilik bo‘yicha an’anaviy oltingugurt tarkibli betonlar kimyoviy chidamliligidan o‘zgarishlar kuzatilmadi. Oltingugurt tarkibli bog‘lovchilar asosidagi betonlar tarkibiga ularni yonuvchanlik darajasini pasaytirish maksadida qo‘shilgan MB-100 markali modifikator betonlarning fizik-mexanik, kimyoviy xossalarini deyarli o‘zgartirmagan holda teplofizik xossalarini ortishiga materialni yonuvchan guruxdan qiyin yonuvchan guruxga o‘tkazilishiga erishildi.

4. Xulosa

Yonuvchanlikni kamaytiruvchi MB-100 markali modifikator qo‘shimchalar asosida tayyorlangan oltingugurt tarkibli betonlarning siqilish va egilishdagi mustaxkamlik ko‘rsatkichlari oddiy oltingugurt tarkibli betonlar mustaxkamligiga nisbatan 3-4% oshganligi kuzatildi.

MB-100 markali modifikator markali qo‘shimchalarning oltingugurt tarkibli betonlar mustaxkamligini ta’minlash vaqtiga ta’siri sezilmadi, an’anaviy oltingugurt tarkibli betonlar singari 1,1 soat davomida mustaxkamlikka erishishiga erishildi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Ziyamuxamedova Umida Alijonovna	Toshkent davlat transport universiteti “Materialshunoslik va mashinasozlik” kafedrasi professori. t.f.d., professor E-mail: z.umida1973@yandex.ru Tel.:+998911915665 https://orcid.org/0000-0001-5005-0477
Nurqulov Fayzulla Nurmuminovich	Toshkent kimyo-texnologiya ilmiy tadqiqot instituti professori, t.f.d., professor https://orcid.org/0000-0002-6546-3431
Djumabayev Alijon Bakishovich	Toshkent davlat transport universiteti “Materialshunoslik va mashinasozlik” kafedrasi professori. t.f.d., professor E-mail:nafasovq@mail.ru Tel.:+998909005677 https://orcid.org/0000-0001-5005-0477
Nafasov Jasurbek Himmat o‘g‘li	Toshkent davlat transport universiteti “Materialshunoslik va mashinasozlik” kafedrasi katta o‘qutuvchisi. t.f.f.d. (PhD) E-mail: nafasovz@mail.ru Tel.:+99897 710 66 93 https://orcid.org/0000-0002-0415-2584
Turg‘unaliyev Elbek To‘xtanazar o‘g‘li	Toshkent davlat transport universiteti “Materialshunoslik va mashinasozlik” kafedrasi assistenti E-mail: elbekturgunaliyev@gmail.com https://orcid.org/0000-0003-3257-5434
Rustamov Mirshohid Ulug‘bek o‘g‘li	Sanoat Energetika Guruhi MChJ XK Muborak XIChK si yetakchi muxandisi, mustaqil izlanivchi Tel.: +998 99 953 92 52 https://orcid.org/0009-0008-1440-5988

Advantages of circular and rectangular seismic barriers

Sh.S. Yuldashev[1][a], A.Sh. Abdunazarov [1][b]
[1]Namangan Engineering-Construction Institute, Namangan, Uzbekistan

Abstract: In the article, the effect of seismic surface waves on the building is determined using the Plaxis 3D software complex using the Finite Element method. The highest displacement amplitudes at each point are determined. Efficiency was analyzed by comparing rectangular and circular seismic barriers.

Keywords: Building, seismic surface waves, finite element method, theory of elasticity, seismic barrier

Aylana va to‘g‘ri to‘rtburchak shaklidagi seysmik to‘siqlarning afzalligi

Yuldashev Sh.S.[1][a], Abdunazarov A.Sh.[1][b]
[1]Namangan muhandislik-qurilish instituti, Namangan, O‘zbekiston

Annotatsiya: Maqolada binoga seysmik sirt to‘lqinlarining ta’siri Plaxis 3D dasturiy majmuasi yordamida Chekli elementlar usulini qo‘llagan holda aniqlangan. Har bir nuqtadagi ko‘chishning eng yuqori amplitudalari aniqlangan. To‘g‘ri to‘rtburchak bilan aylana shaklidagi seysmik to‘siqni qiyosiy taqqoslash orqali samaradorligi tahlil qilingan.

Kalit so‘zlar: Bino, seysmik sirt to‘lqinlari, chekli elementlar usuli, elastiklik nazariyasi, seysmik to‘siq

1. Kirish

Bino va inshootlarni tabiiy va sun’iy tebranishlardan himoya qilish muammosi zamonaviy qurilish uchun muhim ahamiyatga ega. Sun’iy tebranish manbalariga yer osti temir yo‘l liniyalari, avtomobil yo‘llari, og‘ir yuk: uskunalar va jihozlar yuklangan mashinalar hisoblanadi. Hozirgi vaqtda zilzilaga chidamli binolarning zamonaviy konstruktiv tizimlari seysmik qarshilikning maqbul darajasini ta‘minlaydi. Bu ko‘p hollarda binolar va inshootlarning loyihaviy intensivlikdagi zilzilalarga xavfsiz dosh berishiga imkon beradi. Biroq, ayrim hollatlarda seysmik himoya tizimlari bilan jihozlangan inshootlar loyihaviy seysmik yuklar ta’sirida vayron qilingan holatlar mavjud. Shuning uchun aylana va to‘g‘ri to‘rtburchak shaklidagi seysmik to‘siq orqali passiv himoya tizimi dolzarb masaladir.

2. Tadqiqot metodikasi

Seysmik xavfsizlikni ta’minlash va inshootlarning seysmik ta’sirlarga chidamliligini oshirish uchun seysmik to‘siqlar keng qo‘llaniladi. Aylana va to‘rtburchak shaklidagi seysmik to‘siqlarni qiyosiy tahlil qilish va ularning samaradorligini o‘rganish masalalari ko‘rib chiqiladi. Har bir shakldagi to‘siqning seysmik to‘lqinlarni yutish, tarqatish va binolarni himoya qilishdagi xususiyatlari tahlil qilinadi.

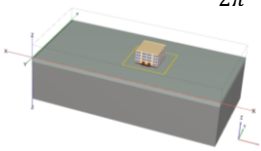
Aylana shaklidagi to‘siqlar seysmik to‘lqinlarni bir xil taqsimlash qobiliyatiga ega. Bu turdagi to‘siqlarni joylashtirish va ularni geometrik jihatdan mustahkamlash osonroq bo‘lib, ular seysmik to‘lqinlarni samarali yutadi va binolarga ta’sirini kamaytiradi.

To‘rtburchak shaklidagi to‘siqlarni joylashtirish va ulardan foydalanish seysmik himoya tizimlarida ko‘proq qo‘llaniladi. Ushbu to‘siqlar seysmik to‘lqinlarni muayyan yo‘nalishlarda yutish va tarqatish qobiliyatiga ega bo‘lib, ular yuqori seysmik xavf hududlarida samarali hisoblanadi.

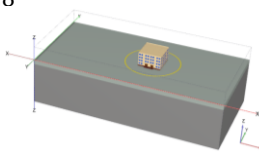
Maqolada aylana va to‘g‘ri to‘rtburchak shaklidagi seysmik to‘siqlarni afzalligini aniqlash bilan bog‘liq bir qator masalalar ko‘rib chiqilgan.

Binoga ta’sir etayotgan seysmik sirt to‘lqinlarni ta’sirini kamaytirish uchun aylana shaklidagi seysmik to‘siq modellashtiriladi va to‘g‘ri to‘rtburchak shaklidagi seysmik to‘siq bilan taqqoslash orqali qaysi shakldagi afzalligini aniqlanadi. Binodan 10 metr uzoqlikda qalinligi 1 metr chuqurligi 3 metr bo‘lgan to‘rtburchak shakldagi seysmik to‘siqni (1-rasm) aylana shakliga keltirib olamiz. To‘rtburchak shaklidagi seysmik to‘siqning uzunligi $l = 178$ metr (2-rasm), aylana radiusini topish uchun:

$$r = \frac{l}{2\pi} = \frac{178}{6.28} = 28$$



1-rasm. To‘rtburchak shaklidagi seysmik to‘siq



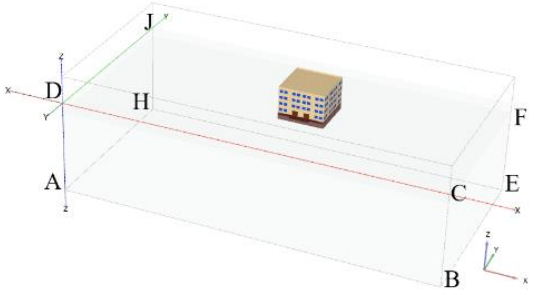
2-rasm. Aylana shaklidagi seysmik to‘siq

Seysmik to‘siqni bino markazidan 28 metr radius uzoqlikda qalinligi 1 metr chuqurligi 3 metr bo‘lgan aylana shaklida modellashtirildi. Modelning uzunligi 200 *m* eni 100 *m* va chuqurligi 50 *m* o`lchamlarga ega. Masalada yer osti suvlari borligi ham hisobga olinadi, yer osti suvlarining sathi 20 *m* chuqurlikda deb olingan. Bino 24 *m* uzunlikda, eni 24

[a] https://orcid.org/0000-0002-3992-9066
[b] https://orcid.org/0009-0003-1614-0913

m va balandligi 14.75 m, qavat balandligi 3,3 m, binoning yer to‘la qismi esa 3 m chuqurlikda joylashgan. birinchi qatlami 5 metr qumloq (suglinka), ikkinchi qatlami 45 metr shag‘alli (galichniy) grunt modellashtirildi.

Masalada cheksiz yarim fazoni chekli soha bilan almashtiramiz. Bunda chegaralarda to‘lqinlarning cheksizlikka intilishini ta’minlovchi quyidagi shartlar qo‘yilgan. Ajratilgan parallelepipedning $AHJD$ va $BEFC$ yog‘larida (a), $ABCD$ va $HEFJ$ yog‘larida (b) hamda $ABEH$ yog‘ida (c) shartlar qo‘yilgan (3-rasm).



3-rasm. Chegaraviy shartlar qo‘yilishi

$$\left.\begin{matrix}\sigma_x = a\rho V_p\dot{u}\\ \tau_{yz} = b\rho V_s\dot{u}\\ \tau_{zy} = b\rho V_s\dot{w}\end{matrix}\right\}\text{a)}\quad \left.\begin{matrix}\sigma_y = a\rho V_p\dot{v}\\ \tau_{xz} = b\rho V_s\dot{w}\\ \tau_{zx} = b\rho V_s\dot{u}\end{matrix}\right\}\text{b)}\quad \left.\begin{matrix}\sigma_z = a\rho V_p\dot{w}\\ \tau_{xy} = b\rho V_s\dot{u}\\ \tau_{yx} = b\rho V_s\dot{v}\end{matrix}\right\}\text{c)} \quad (1)$$

Tadqiqot sohasi 46517 ta chekli elementga va 87829 ta tugunlarga ajratilgan. Cheki elementlarning shakllari noto`g`ri tetraedr shaklida tanlanadi.

Harakat differensial tenglamalar sistemasining tartibi $87829 \times 3 = 260\ 487$ ga teng.

Bu yerda x o‘qi bo‘ylab Reyle to‘lqini harakatlanadi deb tasavvur qilamiz. Materialning fizik-mexanik xususiyatlarini hisobga olgan holda gruntdagi tugunlardagi ko‘chish, tezlik va tezlanishlarini aniqlaymiz.

Dinamik yuk ta’siridagi diskret mexanik sistema harakatining differensial tenglamalar sistemasi quyidagicha ifodalanadi:

$$\boldsymbol{M\ddot{u} + C\dot{u} + Ku = F} \quad (2)$$

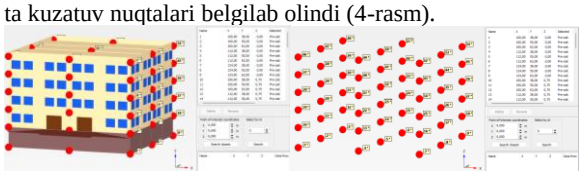
Bu yerda $\boldsymbol{M}$ – massalar matrisasi, $\boldsymbol{C}$ – so‘ndirish matrisasi, $\boldsymbol{K}$ – bikrlik matrisasi va $\boldsymbol{F}$ – dinamik yuk vektori. $\boldsymbol{u}$ – ko‘chish, $\boldsymbol{\dot{u}}$ – tezlik va $\boldsymbol{\ddot{u}}$ – tezlanishlar vektorlari vaqtning uzuluksiz funksiyalari deb olindi.

(2) tenglamalar sistemasini yechish uchun Nyumark usulidan foydalanamiz.

Dinamika masalasini raqamli ifodalashda vaqt iteratsiyasini shakllantirish hisoblash jarayonining barqarorligi va aniqligi uchun muhim omil hisoblanadi.

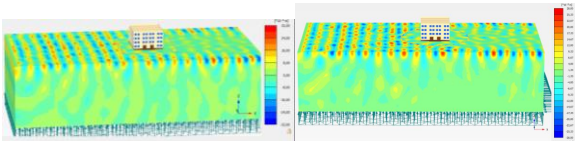
Nyumark usulining vaqt iteratsiyasi koeffitsentlarini $\alpha = 0.25$ va $\beta = 0.5$ deb qabul qilamiz.

Binoga ta’sir etayotgan seysmik sirt to‘lqinlarni aniqlash va taqqoslash uchun binoning har qavatidan 9 ta jami esa 54 ta kuzatuv nuqtalari belgilab olindi (4-rasm).



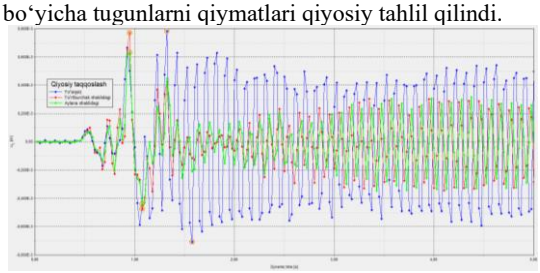
4-rasm. Kuzatuv nuqtalari

Seysmik sirt to‘lqinlarni tarqalishini Garmonik kuch orqali hosil qilindi. Garmonik kuchning fazasi 0, amplitudasi 1 va chastotasi 10 Hz davomiyligi 5 sekund deb olindi.



5-rasm: Seysmik sirt to‘lqinlarni binoga ta’sir etish jarayoni

Binoning oldindan belgilab kuzatuv nuqtalari yordamida z bo‘yicha tugunlarni qiymatlari qiyosiy tahlil qilindi.



6-rasm. 34-kuzatuv nuqtasidagi ko‘chishni taqqoslash grafiki

6-rasmda, atrofida xech qanday to‘siq joylashmagan modeldagi binoning 34-kuzatuv nuqtasida seysmik sirt to‘lqinning u_z o‘qi bo‘yicha ko‘chishning maksimal qiymati u_{zmax} =0,782 mm, to‘g‘ri to‘rtburchak shaklidagi seysmik to‘siqli modeldagi binoda u_{zmax} =0,770 mm, aylana shaklidagi seysmik to‘siqli modeldagi binoda u_{zmax} =0,632 mm ni tashkil etdi. Qiyosiy taqqoslanganda, atrofida xech qanday to‘siq joylashmagan holga nisbatan to‘rtburchak shaklidagi seysmik to‘siqli modeldagi binoning 34-kuzatuv nuqtasidagi ko‘chish 1.53%, aylana shaklidagi seysmik to‘siqli modelda binoda 19.18% ga teng bo‘lgan seysmik to‘siqlar samaradorligi qayd etildi.

7-rasm. 49-kuzatuv nuqtasidagi tezlikni taqqoslash grafiki

7-rasmda, atrofida xech qanday to‘siq joylashmagan modeldagi binoning 34-kuzatuv nuqtasida seysmik sirt to‘lqinning v_z o‘qi bo‘yicha tezlikning maksimal qiymati v_{zmax} =8,831 sm/s, to‘g‘ri to‘rtburchak shaklidagi seysmik to‘siqli modeldagi binoda v_{zmax} =2,502 sm/s, aylana shaklidagi seysmik to‘siqli modeldagi binoda v_{zmax} =2,308 sm/s ni tashkil etdi. Qiyosiy taqqoslanganda, atrofida xech qanday to‘siq joylashmagan holga nisbatan to‘rtburchak shaklidagi seysmik to‘siqli modeldagi binoning 34-kuzatuv nuqtasidagi tezlik 71.67%, aylana shaklidagi seysmik to‘siqli modelda binoda 73.86% ga teng bo‘lgan seysmik to‘siqlar samaradorligi qayd etildi.

8-rasm. 34-kuzatuv nuqtasidagi tezlanishni taqqoslash grafiki

8-rasmda, atrofida xech qanday to‘siq joylashmagan modeldagi binoning 34-kuzatuv nuqtasida seysmik sirt to‘lqinning a_z o‘qi bo‘yicha tezlanishning maksimal qiymati a_{zmax} =83,94 *sm/s*^{2}, to‘g‘ri to‘rtburchak shaklidagi seysmik to‘siqli modeldagi binoda a_{zmax} =35,28 *sm/s*^{2}, aylana shaklidagi seysmik to‘siqli modeldagi binoda a_{zmax} =33,16 *sm/s*^{2} ni tashkil etdi. Qiyosiy taqqoslanganda, atrofida xech qanday to‘siq joylashmagan holga nisbatan to‘g‘ri to‘rtburchak shaklidagi seysmik to‘siqli modeldagi binoda tezlanish 57.97%, aylana shaklidagi seysmik to‘siqli modeldagi binoda tezlanish 60,50% ga teng bo‘lgan seysmik to‘siqlar samaradorligi qayd etildi.

3. Xulosa

Bino atrofiga xech qanday to‘siq joylashtirilmagan binoga nisbatan bir xil koordinatada joylashgan to‘rtburchak shakldagi seysmik to‘siqli modeldagi binoda ko‘chish o‘rtacha 20.05%, tezlik 54.72% va tezlanish 48.84%, aylana shakldagi seysmik to‘siqli modeldagi binoda ko‘chish o‘rtacha 24.11%, tezlik 56.70% va tezlanish 50.13% ga seysmik to‘siqlar samaradorligi qayd etildi.

Bu tahlilga binoan binoga ta’sir etayotgan seysmik sirt to‘lqinlar ta’sirini kamaytirish uchun to‘rtburchak va aylana shaklli seysmik to‘siqlar modellashtirilganda, ikki turdagi seysmik to‘siq ham ijobiy natija berdi. Aylana shaklli seysmik to‘siq to‘rtburchak shaklli seysmik to‘siqqa qaraganda afzalligi aniqlandi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Yuldashev Sharafitdin Sayfitdinovich	Namangan muhandislik-qurilish instituti, “Materiallar qarshiligi va mexanika” kafedrasi professori, t.f.d. Sh.yuldashev1953@gmail.com Tel.: +998974275438 https://orcid.org/0000-0002-3992-9066
Abdunazarov Akbarjon Shamsuddin o‘g‘li	Namangan muhandislik-qurilish instituti, “Qurilish materiallari va buyumlari” kafedrasi o‘qituvchisi, Abdunazarovakbar16@gmail.com Tel.: +998911860505 https://orcid.org/0009-0003-1614-0913

Supporting components: key paradigms and information systems

M. S. Burikhodjaeva[1][a], Sh.R. Sharapova[1]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: Currently, systematic management of the supply chain is becoming a promising direction of research, the structure of which continues to develop in the conditions of integration and mutual adaptation of product, service, information and intellectual flows, which in turn opens up new opportunities for interdisciplinary analysis. Unlike logistics, the basic theoretical and methodological foundations are already systematized, integrated, in the systematic management of the supply chain (mainly in multilevel, supply chains), this process is only beginning its development. Therefore, this article analyzes theories, methods and models, economic indicators, existing terms and definitions, taking into account the issues of optimization of supply chains and the requirements for them in terms of reliability, stability, flexibility. An approach is proposed to the formation of systematic management of logistics systems based on the interconnection of operational, tactical and strategic management.

Keywords: The concept of" delivery", SCM (supply chain management), SCOR, paradigm, logistics concept, management. marketing, optimization, integrated management, strategy, resource, supply chain planning

Qo‘llab-quvvatlovchi komponentlar: asosiy paradigmalar va axborot tizimlari

Burixojayeva M. S.[1][a], Sharapova Sh.R.[1]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Hozirda yetkazib berishlar zanjirini tizimli boshqarish tadqiqotning istiqbolli yo‘nalishiga aylanib bormoqda, uning tuzilishi mahsulot, xizmat, axborot va intellektual oqimlarning integratsiyasi va o‘zaro moslashuvi sharoitida rivojlanishda davom etmoqda, bu esa o‘z navbatida fanlararo tahlil uchun yangi imkoniyatlarni ochib boradi. Logistikadan farqli o‘laroq asosiy nazariy va uslubiy asoslar allaqachon tizimlashtirilgan, integratsiyalashgan, yetkazib berishlar zanjirini tizimli boshqarishda (asosan ko‘p darajali, yetkazib berishlar zanjirlarida) bu jarayon faqat o‘z rivojlanishini boshlamoqda. Shuning uchun ushbu maqolada yetkazib berishlar zanjirlarini optimallashtirish masalalari va ishonchlilik, barqarorlik, moslashuvchanlik nuqtai nazaridan ularga qo‘yiladigan talablarni hisobga olgan holda nazariyalar, usullar va modellar, iqtisodiy ko‘rsatkichlar, mavjud atamalar va ta’riflar tahlil qilinadi. Operasion, taktik va strategik menejmentning o‘zaro bog‘liqligiga asoslangan logistika tizimlarini tizimli boshqarishni shakllantirishga yondashuv taklif etiladi.

Kalit so‘zlar: "Yetkazib berish" tushunchasi, SCM (yetkazib berishlar zanjiri boshqarish), SCOR , paradigma, logistika tushunchasi, menejment. marketing, optimallashtirish, kompleks boshqarish, strategiya, resurs, yetkazib berishlar zanjirini rejalashtirish

1. Kirish

Hozirgi vaqtda yetkazib berishlar zanjirlarida oqimlarni kompleks boshqarish sohasi allaqachon o‘lchovlar, modellar, usullar va fanlarning keng doirasini qamrab oladi, ammo keyinchalik yetkazib berishlar zanjirlarining "intellektualashuvi" bilan bog‘liq holda shakllanishi mumkin bo‘lgan alohida ilmiy yo‘nalishni anglatmaydi.

Uzoq muddatli istiqbolda ushbu tadqiqot sohasining barqaror rivojlanishi uchun uning universal tuzilishini, tadqiqotchilar va amaliyotchilar tomonidan turli kontekstlarda oqim integratsiyasi samaradorligini baholash uchun ishlatilishi mumkin bo‘lgan “vositalarni” ni shakillantirish kerak, tadqiqot boshqa fanlar paradigmalariga emas, balki fanga tegishli paradigma asosida olib borilishi kerak [Veber, 1987]. Shu munosabat bilan muallif murakkab tizimlar nazariyasini rivojlanayotgan paradigmalar uchun potensial asos sifatida ko‘rib chiqishni taklif qilindi, chunki u ko‘p o‘lchovli, fanlararo va ko‘plab o‘zaro bog‘liq komponentlar, chiziqli bo‘lmagan teskari aloqa mexanizmlari va moslashuvchan xususiyatlarga ega rivojlanayotgan, moslashuvchan, o‘zini o‘zi tashkil etuvchi dinamik obyektlarni o‘rganishga qaratilgan [Mitleton-Kyelli, 2003]. Murakkab tizimlar nazariyasi doirasida biznes jarayonlarining yagona to‘plamini o‘z ichiga olgan va yetkazib berishlar zanjirlarini tahlil qilish, loyihalash, nazorat qilish va boshqarishda xalqaro tarmoqlararo standart sifatida tan olingan turli xil mavhum modellar bilan bog‘liq fundamental paradigmalar ishlab chiqilmoqda. 1990 yillarning boshlarida birinchilardan bulib yetkazib berishlar zanjiri operasiyalarining ma’lumot modeli (ingl. Supply Chain Operations Reference Model, SCOR) yaratildi, u

[a] https://orcid.org/0000-0002-9396-4428

beshta biznes-jarayon (bajarish, ta'minlash, yetkazib berish, qaytarish, rejalashtirish)ga asoslangan. Ushbu ma'lumotnoma (standart) modelning barcha darajalarida jarayonlarning samaradorligini nazorat qilishni ta'minlaydigan muvozanatli ko'rsatkichlarning o'rnatilgan tizimini o'z ichiga oladi. Ya'ni, yetkazib berish zanjirini boshqarishning ushbu operasion modeli yetkazib berishlar zanjirining eng yaxshi ko'rsatkichlariga erishish uchun qaysi biznes jarayonlarini va ularni qanday amalga oshirish kerakligini belgilaydi.

2. Tadqiqot metodikasi

SCOR -modeli iyerarxik uch darajali metrik tizimga ega bo'lib, unda yuqori darajadagi muammolarni tashxislash uchun quyi darajadagi ko'rsatkichlar qo'llaniladi. [Matushkin va Gorbunov, 2016]. Birinchi darajadagi ko'rsatkichlar umuman yetkazib berishlar zanjiri holatini tashxislaydi va asosiy samaradorlik ko'rsatkich (KPI) sifatida qaralishi mumkin. Ikkinchi va uchinchi darajadagi ko'rsatkichlar yetkazib berishlar zanjirining KPI -lariga nima sabab va nima ta'sir qilishini tushunishga imkon beradi. Bularga xususiy ishlash va samaradorlik ko'rsatkichlari kiradi. [Matushkin va Gorbunova, 2016]. SCOR modeli yetkazib berishlar zanjirining standartlarini ishlab chiqish va takomillashtirish maqsadida Xalqaro tashkilot operasiyalar zanjirining ma'lumotlar modelini (inglizcha: Design Chain Operations Reference Model) ishlab chiqdi, u ham beshta biznes jarayonlari (rejalashtirish, tadqiqot, dizayn, integratsiya, takomillashtirish) identifikasiyaga asoslangan. Operasion samaradorlik maqsadlari uchun mezonlarni belgilovchi SCOR modelining ko'rsatkichlari beshta operasion samaradorlik xususiyatlariga mos keladi (ishonchlilik, sezgirlik, tezkorlik, xarajatlar, aktivlar). Yetkazib berishlar zanjiri uchun , mustaqil ravishda yoki oldingi ikkita model bilan birgalikda ishlatilishi mumkin bo'lgan uchinchi model - SCOR (Customer Chain Operations Reference model) ni ishlab chiqdi. Shuni ta'kidlash kerakki, standart SCOR modeli biznes funktsiyalarini texnologik va tijoratga bo'linishni nazarda tutmaydi [Sergeyev va boshq., 2015]. Shuningdek, tijorat yordamchi funktsiyalari SCOR modelida ko'rib chiqilmaydi, lekin SCOR modelining predmeti bo'lib, mahsulot prototipi SCOR modelida ifodalanadi va mahsulotning ishga tushirilishi keyingi PLCOR modelida tasvirlanadi. Ushbu model, boshqalarga o'xshab, beshta biznes jarayonidan (rejalashtirish, kontsepsiyani shakllantirish, takliflarni ishlab chiqish, ishga tushirish, qayta ko'rib chiqishdan) iborat. 2006 yilda Integrated Business Reference Framework (IBRF, Tavsiya etilgan integratsiyalashgan biznes tuzilmasi) deb ataladigan yaratilish e'lon qilindi, u uchta zanjir, ta'minot, muhandislik, iste'molchilar, ya'ni modellarni SCOR, DCOR, CCOR, yagona qiymat zanjiriga birlashtirishi kerak. [Sergeyev va boshq., 2015]. Yetkazib berishlar zanjiri tomonidan taklif qilingan ma'lumotlar modellariga qo'shimcha ravishda, ixtiyoriy tarmoqlararo savdo standartlari uyushmasi, tarqatish kanallarini boshqarishga qaratilgan hamkorlikda rejalashtirishni prognozlash va to'ldirish modeli (ingl. Collaborative Planning Forecasting, and Replenishment), ishlab chiqilgan. Ushbu model SCOR modelidan ko'ra uning ko'lami kengroqdir, shuning uchun u faqat ba'zi kompaniyalar orasida keng tarqalgan. Eng taniqli ma'lumotlar modellari M.Porter tomonidan ishlab chiqilgan qiymat zanjiri; xalqaro standartlashtirish tashkiloti (inglizcha: Value chain, xalqaro standartlashtirish tashkiloti) tomonidan ISO-versiyalari 9000 standartlari doirasida ishlab chiqilgan biznes-jarayonlarning mos yozuvlar modellari (ruscha ekvivalenti GOST RISO 9000 standarti, ishlab chiqilgan Rossiya ilmiy-texnik tadqiqot instituti, VNIIS), shuningdek, sifat menejmenti bo'yicha Yevropa jamg'armasi (ingl. European Foundation for Quality Management) tomonidan taklif qilingan mukammallikning ma'lumotnoma modeli (ingl. Excellence model). Ko'rib chiqilayotgan biznes modellarining asosiy kamchiliklari ularning tavsifiy xususiyatidir, chunki ma'lumotlar modellari tavsiflovchi hisoblanadi. Shuning uchun, yetkazib berish zanjirlarini rejalashtirish va qayta loyihalashda, biznes jarayonlari maqbul bo'lishiga kafolat yo'q va tizimning belgilangan ishonchliligi va samaradorligiga erishiladi [Bochkarev, 2015].

Murakkab tizimlar nazariyasida analitik va algoritmik shakllarda aks ettirishga asoslangan murakkab modellar qo'llaniladi. Maqsadli qiymatlar korxonaning biznes modellariga muvofiq belgilanadigan haqiqiy qiymatlarni boshqarish uchun amalga oshiriladigan kompyuter tizimlari taqdim etilgan ko'plab mos yozuvlar modellari dasturiy ta'minotni ishlab chiqishni avtomatlashtirish vositalari (ingl. computer-aided software engineering, CASE-texnologiyalari) amalda qo'llaniladi. Misol uchun: quyidagi kompyuter tizimlari Germaniyaning dasturiy ta'minot Software AG kompaniyasi tomonidan ishlab chiqilgan ARIS (ingl. Architecture of Integrated Information Systems) AllFusion ERwin Data Modeler (raneye ERwin) shuningdek OOwin, BPwin , mantiqiy ishlar tomonidan yaratilgan va grafik operasion tizimlarga yo'naltirishni o'z ichiga oladi: bu esa win qo'shimchasi mavjudligidan dalolat beradi. Ushbu tizimlar asosan loyihalashda ikkita yondashuvdan foydalanadi: umumiy metodologiyalarga asoslangan tarkibiy va obyektga yo'naltirilgan (masalan, tarkibiy tahlil va dizayn metodologiyasi (SASD), uni yanada rivojlantirish SADT metodologiyasida keltirilgan). IDEF metodologiyasi eng puxta ishlab chiqilgan deb hisoblanadi, bu nafaqat biznes jarayonlarini, balki funksional bloklarni, kompaniyadagi turli obyektlarni va ulardagi harakatlarni tavsiflashga imkon beradi. Taqdim etilgan metodologiyalar dasturlash tillariga kirmaydigan yagona modellashtirish tili-UML kabi murakkab tizimlarni tavsiflash uchun grafik tildan foydalanishga asoslangan. Ushbu til turli xil diagrammalar(IDEF0, IDEF1, IDEF1X, IDEF2, IDEF3, IDEF4, IDEF5 kabi xususiy metodikalar shaklida) tizimini o'z ichiga oladi, uning asosida loyihalashtirilgan tizim g'oyasi qurilishi mumkin [Petrova i Voxmyanina, 2012].

Tizimlarni dinamik modellashtirish uchun IDEF2 metodologiyasini shakllantirish dinamik tizimlarni tahlil qilishning murakkabligi sababli deyarli boshlang'ich darajada to'xtatildi. Hozirgi vaqtda statik IDEF0 diagrammalari rangli to'plamini Petri (ingl. Color Petri Nets), to'rlariga asoslangan dinamik modellarga aylantirishga imkon beradigan algoritmlar va kompyuter dasturlari mavjudligiga qaramay, dinamik murakkab tizimlarni tavsiflash uchun IDEF xususiy metodologiyalaridan foydalanish hali ham ushbu xususiyatlar bilan cheklangan.

Shu munosabat bilan, yetkazib berishlar zanjirlarini boshqarish (ingl. Supply Chain Execution) va yetkazib berishlar zanjirini rejalashtirish (ingl. Supply Chain Planning) uchun quyi tizimining tarkibiy qismlari deb hisoblanishi mumkin bo'lgan tavsiflangan

metodologiyalarga qo‘shimcha ravishda, RFID texnologiyalariga asoslangan yetkazib berishlar zanjirini bajarish (ingl. Transport Management Systems, TMS, TMS), ombor harakatlanuvchi tarkib (Warehousing Management Systems, WMS) (angl. Fleet Management Systems) va boshqalar transportni boshqarish tizimlariga kiritilgan. Axborot texnologiyalaridan foydalanish ayniqsa integratsiyalashgan deb nomlangan nisbatan yangi logistika konsepsiyasi va rivojlanayotgan integratsiyalashgan yetkazib berishlar zanjiri boshqaruvi samarali logistika tizimlarini qurishga yordam beradi [Dibskaya va boshq., 2010]. Uning paydo bo‘lishidan oldin mikro-iqtisodiy konsentrasiya va tarqatish tizimlarini, mahsulot va xizmatlarning makro-iqtisodiy tarqatish tizimlarini va makro-iqtisodiy konsentrasiya va tarqatish tizimlarini loyihalash, shakllantirish va optimallashtirish bo‘yicha uslubiy apparatlarni ishlab chiqishda qo‘llaniladigan uchta asosiy boshqaruv konsepsiyasi (menejment, marketing, logistika) paydo bo‘ldi. [Tyapuxin, 2002; Dibskaya, 2017]. Atrof-muhitning o‘zgaruvchanligi murakkab dinamik logistika tizimlarining samaradorligini tizimli ravishda baholash uchun qo‘shimcha tadqiqotlar va muqobil yondashuvlarni izlashni talab qiladi. Rasional boshqaruv qarorlarini qabul qilish uchun ularning ishlash samaradorligi darajasini har tomonlama baholash vositalaridan foydalanish kerak [Miftyaxetdinov, 2010], shuning uchun optimallashtirish bilan bog‘liq turli xil logistika qarorlarini asoslashda dinamikada turli xil logistika jarayonlarini tavsiflashga asoslangan ko‘p funksional yondashuvlar tobora ko‘proq foydalanilmoqda. Simulyasiya modellari keng tarqalmoqda, ularning o‘ziga xos xususiyati vaqt funktsiyasi shaklida ishlashning asosiy ko‘rsatkichlarini baholashdir, bu tizimni vaqtinchalik rejimlarda baholashga imkon beradi. Shu bilan birga, natija logistika tizimlarini tahlil qilish va loyihalash uchun maxsus dasturiy ta’minot yordamida ishlaydigan model shaklida baholanadi [Toluyev, 2005; Shinkarenko va Ananko, 2014]. Optimallashtirish muammolarini hal qilishning raqamli usullarini aks ettirishning analitik va algoritmik shakllariga asoslangan dinamik tizimlar ishini kompleks baholashning ushbu tizimlari yetkazib berishlar zanjirini boshqarishning asosiy quyi tizimini – yetkazib berishlar zanjirini optimallashtirishni tashkil qilishi mumkin (1-rasm).

Yetkazib berishlar zanjirini optimallashtirish tizimlari odatda AnyLogic, PowerSim, IThink, Extend, Rethink, Arena, FlexSim, Simul8, Simio, AnyLo-gistix kabi universal modellashtirish tizimlari yordamida ishlab chiqilgan simulyasiya yoki mavzuga xos (ProMod, AutoMod, WITNESS, TED) modellarini yaratishga asoslangan.

1-rasm. Yetkazib berishlar zanjirini kompleks boshqarish

3. Xulosa

Xulosa qilib shuni ta’kidlash munkinki, ushbu modellar va usullarning kombinasiyasi, shuningdek yetkazib berishlar zanjirlarida logistika funktsiyalarining ajralmas xususiyatini aks ettiruvchi zamonaviy nazariyalarning minimal to‘plamidan foydalanish murakkab tizimlarni tavsiflashda va hisoblash tajribalarini o‘tkazishda natijalarning aniqligi va ishonchliligi darajasini oshirishga yordam beradi va modellashtirishda kompyuterga ishlov berish soddalashtiriladi. Yetkazib berishlar zanjirini kompleks boshqarishga ko‘rib chiqilgan yondashuv yetkazib berishlar zanjirlarida logistika funktsiyalarini maqbul boshqarish bo‘yicha qarorlarni qabul qilishning umumlashtirilgan metodologiyasi va nazariyasini ishlab chiqish, shuningdek ularning atrof-muhitning bezovta qiluvchi ta’siriga chidamliligini tahlil qilish va baholash uchun asos bo‘lishi mumkin. Buni aniqlashtirish uchun logistikaning funksional yo‘nalishlarini, asosiy va qo‘llab-quvvatlovchi logistika funktsiyalarini qayta ko‘rib chiqish, logistika xarajatlarini hisoblash tamoyillarini, rentabellik standartlarini, logistika provayderlari narxlarini modernizasiya qilish va tuzilish xususiyatlarini hisobga olgan holda samarali transport va ombor infratuzilmasini rivojlantirish tamoyillarini umumlashtirilgan logistika xarajatlari modelidan shakllantirish kerak bo‘ladi. Samarali yechimlarni tanlash uchun modellarning oqilona murakkabligini ta’minlaydigan maxsus kompyuter dasturlaridan foydalangan holda yangi analitik apparatni ishlab chiqish amaliy vazifalarga analitik bog‘liqliklarga yaqinlashish uchun zarur shart-sharoitlarni yaratadi, ularning maqsadi, qoida tariqasida yurtimizda logistika xarajatlarini global o‘rtacha darajaga tushirishdan iboratdir.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Burihodjayeva Maloxat Sobitovna	Toshkent davlat transport universiteti “Transport logistikasi” kafedrasi katta o‘qituvchisi, maloxatburixadjaeva@gmail.com Tel.: +998 971957779 https://orcid.org/0000-0002-9396-4428
Sharapova Shahzoda	Belarus milliy texnika universiteti magistranti sharapovashahzoda@mail.ru Tel.: +998977005245

Mathematical model of fastening conditions in piggyback transport, taking into account different conditions

Z.G. Adilova (Mukhamedova)[1][a], D.Sh. Boboev[1][b], N.B. Axtamov[1][c]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: The main goal of the work is to determine the forces affecting the vehicle loaded on the railway platform and to systematize them. In this article, analyzes of security requirements are carried out on the basis of cargo transportation. In the study, the options for choosing the type of fastening means were considered based on the analysis of the forces acting on the mass of the transported load. Transportation of semi-trailers was chosen as a study of the types of transport, based on the stability conditions of the forces acting on the transportation of semi-trailers in rail transport, truck transport, trailer transport, road transport and semi-trailer transport. It is possible to determine the number and requirements of fastening means by determining the results of the influencing forces.

Keywords: safe transportation, fastening elements, road train, wagon, type of transport, type of transport, loading and unloading, traffic movement, acting forces

Turli sharoitlarni inobatga olib kontreyler tashishlarda mahkamlash shartlarining matematik modeli

Adilova (Mukhamedova) Z.G.[1][a], Boboev D.Sh.[1][b], Axtamov N.B.[1][c]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Ishdan asosiy maqsad temir yo‘l platformasiga ortilgan avtotransport vositasiga ta’sir ko‘rsatuvchi kuchlarni aniqlash va ularni tizimlashtirishdan iborat. Ushbu maqolada yuklarni kontreyler tashishlar asosida xavfsizlik talablarini ta’minlash tahlillari olib borilgan. Tadqiqotda tashilayotgan yukning massasiga bog‘liq holda ta’sir qiluvchi kuchlarning tahlili hisobiga mahkamlash vositalari turini tanlash imkoniyatlari ko‘rib chiqilgan. Tashish turlarini tadqiq qilish sifatida avtopoyezd tashish, tirkama tashish, avtomobil transportida tashish va temir yo‘l transportidagi yarim tirkamalarni tashishda ta’sir qiluvchi kuchlarning turg‘unlikni ta’minlash shartlarini asoslashda yarim tirkamlarni yetkazib berish tanlangan. Ta’sir qiluvchi kuchlarning natijalovchilarini aniqlash yordamida mahkamlash vositalari sonini va talablarini belgilash imkoniyati yaratilgan.

Kalit so‘zlar: xavfsiz tashish, mahkamlash elementlari, avtopoyezd, vagon, transport turi, tashish turi, yuklash va tushirish, transport harakati, ta’sir qiluvchi kuchlar

1. Kirish

Hozirgi kunda xalqaro tajriba shuni ko‘rsatmoqdaki temir yo‘l transportida kontreyler tashishlarda yuklarni yetkazib berish samarali hisoblanadi. Shu nuqtai nazardan “O‘TY” AJ sharoitida yuklarni kontreyler tashishlarda yetkazib berish bir muncha afzalliklarga ega, bundan kelib chiqilsa aynan Respublikamiz temir yo‘llarida kontreyler tashishlar yangi yo‘nalish sanaladi. Qolaversa, bu sohada o‘z yechimini kutayotgan muammolar talaygina ya’ni harakat xavfsizligini ta’minlash uchun albatta bu tashishlarning texnik shartlarini, mahkamlash qoidalarini mahalliy standartlarga moslashtirgan holatda ishlab chiqish lozimdir [1-4, 7, 10].

Yuklarni tashishga qo‘yilgan asosiy talablar ya’ni yuklarning o‘z manziliga xavfsiz holda yetib borishida turg‘unlik mezonlarini tekshirishdan iborat. Yuk jo‘natuvchi yuklarni o‘z manziliga yetkazishda keltirilgan ta’sir etuvchi omillarning barchasini inobatga olgan holda samarali mahkamlashlash usulini tanlash va tashishni amalga oshirish kerak bo‘ladi. Tadqiqotda Dalamber tamoyili, Nyuton qonunlari, matematik modellashtirish va tizimli yondashuvlar usulidan foydalanilgan [1-4].

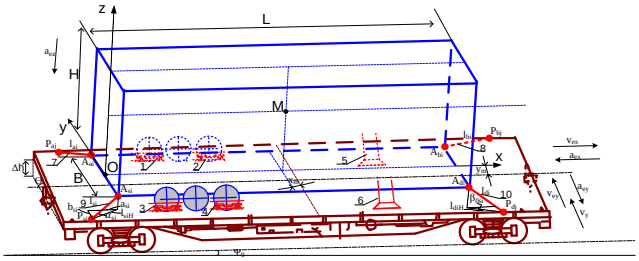
Temir yo‘l transportida kontreyler tashishni tashkil etishda avtopoyezd, yuk avtomobili, tirkama, shatakchi va yarim tirkama kabi tashish birliklarini belgilangan talablarga rioya qilgan holda temir yo‘lning 13-9961, 13-4095, 139004M modellaridagi platformalaridan yuklashda foydalanish mumkin. Ushbu platforma modellarida tushirilgan yuk maydoni bo‘lib, tashish birliklarini mahkamlash uchun g‘ildirak juftliklarini o‘rnatishda qo‘llaniladi. Bundan tashqari, bu platformalar yordamida konteynerlar va yechiluvchi avtomobil kuzovlarini tashishni inobatga olgan holda o‘rnatish joylari mavjud [1].

[a] https://orcid.org/0000-0002-1825-2447
[b] https://orcid.org/0000-0003-0785-2209
[c] https://orcid.org/0009-0004-8987-961X

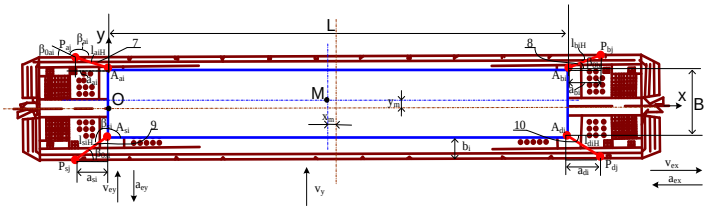
Kontreyler tashishlarda yuk sifatida tashiladigan yukli avtotransport vositalarining o‘lchamlari oddiy yuklardan kattaroq bo‘lishi mumkinligini inobatga olib, me’yoriy hujjatlarda belgilangan temir yo‘l transporti platformalaridan foydalaniladi. Tashish birliklari temir yo‘l platformasi bo‘ylama simmetriya tekisligiga simmetrik joylashtiriladi. Ularning ko‘ndalang yo‘nalishlarda siljishi 100 mm dan hamda platforma ramasidan tashqariga chiqish 400 mm dan oshmasligi kerak. Platformaga bir nechta tashish birliklarini ortishda yuklarni joylashtirish va mahkamlash bo‘yicha texnik shartlarda keltirilgan ko‘rsatmalarga to‘liq rioya qilinadi [5-6, 8-9].

2. Adabiyotlar tahlili va metodologiyasi

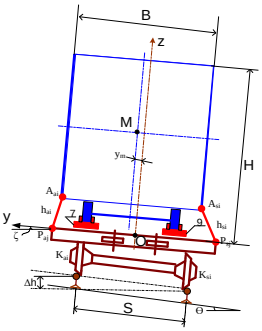
Avtopoezdlarni maxkamlash va joylashtirish chizmalarini uning ko‘ndalang bo‘ylama yo‘nalishlardagi ko‘chishini aniqlashda vagon-mahkamlash-yuk tizimidan foydalaniladi va kuchlarni XYZ o‘lchamli fazoda joylashishi e’tiborga olinishi lozim [11-12]. Avtotransport vositalarini ochiq harakat tarkiblariga joylashtirish va mahkamlash chizmalari ularning siljishi tebranishi natijasida mahkamlash elementlariga tushadigan zo‘riqishlarni aniqlash yuzasidan shuningdek, harakat tarkiblarini temir yo‘l egriligida harakatlanishi va tashqi shamol ta’siridagi siljishini aniqlash yuzasidan takliflar [2]-ilmiy izlanishda batafsil yoritib o‘tilgan. Biroq ochiq harakat tarkibida tashilayotgan avtopoyezdlarni mahkamlash tartibi haqida qisman to‘xtalib o‘tilgan, nimagaki avtopoezdlar tuzilishiga ko‘ra [2]-ilmiy izlanishda ko‘rilgan avtotexnika chizmasidan tubdan farq qiladi shu maqsadda avtopoezdlarni “O‘TY” AJ sharoitlariga moslashtirgan holda mahkamlash shartlarini ishlab chiqish dolzarb ahamiyat kasb etadi. Universal to‘rt o‘qli platformaga (model 13-9961) yarim tirkama joylashtirilgan va mahkamlash ishlari bajarilgan holatda harakat davomidagi ta’sir qiluvchi kuchlarni asoslash muhim ahamiyat kasb etadi (1-rasm).



a) yon tomondan ko‘rinishi



b) yuqoridan ko‘rinishi



v) orqa tomondan ko‘rinishi

1-rasm. Universal to‘rt o‘qli platformaga (model 13-9961) yarim tirkamani joylashtirish va mahkamlash sxemasi

Tahlil natijalari (1-rasm)ga ko‘ra, harakat tarkibiga doimiy ta’sir qiluvchi kuchlardan tashqari, harakat davomida qiyalik va egriliklarda hosil bo‘luvchi boshqa kuchlar ham ta’sir qiladi.

1-rasmda $\overline{Q}_{yuk}$-avtopoyezd, yarim tirkamaning yuklangan yoki bo‘sh holatdagi og‘irligi, N;

n_i-mahkamlash vositalari (tortqich) ning soni;

H,L,B -mos ravishda, yarim tirkamaning balandligi, uzunligi va eni, m;

$l_{ai}, l_{bi}, l_{si}, \ l_{di}$-mahkamlash vositasi (tortqich) ning uzunligi, m;

$h_{ai}, h_{bi}, h_{si}, h_{di}$-mahkamlash vositasi (tortqich) ning ko‘ndalang o‘qdagi proyeksiyasi balandligi, m;

$a_{ai}, a_{bi}, a_{si}, a_{di}$- mahkamlash vositasi (tortqich) ning bo‘ylama o‘qdagi proyeksiyasi uzunligi, m;

$b_{ai}, b_{bi}, b_{si}, b_{di}$- mahkamlash vositasi (tortqich) ning ko‘ndalang o‘qdagi proyeksiyasi uzunligi, m;

α_{ai},α_{bi},α_{si},α_{di}- mahkamlash vositasi (tortqich) va platforma tekisligi orasidagi burchak, ^{o};

β_{ai},β_{bi},β_{si},β_{di}- mahkamlash vositasi (tortqich) ning proyeksiyasi va platformaning x o‘qidagi tekisligi orasidagi burchak, ^{o};

Δh -tashqi va ichki rels balandliklari farqi, $\Delta h = \frac{S \cdot v^2}{g \cdot R}$, m;

S -rels o‘qlari orasidagi masofa, m;

θ - tashqi relsning ichki relsga nisbatan balandligini tavsiflovchi burchak, $\theta = arctg(\frac{\Delta h}{S})$, ^{o};

ξ -platformaning bo‘ylama x o‘qda siljiganida yuklangan vagon ramasi egilishi hisobga olinadigan burchak, ^{o};

ζ - platformaning ko‘ndalang y o‘qda siljiganida yuklangan vagon ramasi egilishi hisobga olinadigan burchak, ^{o};

ψ_0-tarkibning qiyalikda harakatlanish burchagi, $\psi = arctg(\frac{\Delta H}{l_y})$, °.

3. Natija va muhokama

Temir yo‘l uchastka va yo‘nalishlari bo‘yicha yuklari harakat tezliklari ifodalarini [14, 15] tahlil qilish natijasida yuklari harakat tezliklariga ta’sir ko‘rsatuvchi omillar darajalar kesimida tizimlashtirildi. Tizimlashtirish temir yo‘l transporti PHGning asosiy ko‘rsatkichlaridan biri bo‘lgan uchastka va marshrut tezliklari misolida amalga oshirildi. Uchastka tezligini aniqlash ifodasiga [14, 15] birinchi darajali ($O_{uch.1}$) ikki xil omil bilan tavsiflanadi, ya’ni texnik (temir yo‘l uchastkalarining uzunligi (L_{uch})) va texnologik (temir yo‘l uchastkalarida poyezdlarning yurish (t_{yur})), oraliq stansiyalarda poyezdlarning umumiy o‘rtacha turib qolish ($\sum t_{or.st}$) va tezlashish va sekinlashish harakatlari uchun sarflagan ($\sum t_{t/s}$) vaqtlari.

Platformaga ortilgan avtotransport vositasiga uning massasi (Q_y)dan tashqari harakat vaqtida tezlanish va sekinlanish jarayonida hamda manyovr va saralash vaqtida ta’sir qiladigan bo‘ylama inersiya kuchlari (F_b); harakati vaqtida va yo‘lning egri burilish joylarida ta’sir qiladigan ko‘ndalang inersiya kuchlari (F_k); harakat vaqtida platforma tebranishlari keltirib chiqargan vertikal inersiya kuchlari (F_v); shamol yuklamasi (W_{sh}) hamda bo‘ylama ($F_{(ish.b)}$) va ko‘ndalang ($F_{(ish.k)}$) yo‘nalishdagi ishqalanish kuchlari ta’sir qiladi [3]. Ta’sir qiluvchi kuchlarning kattaliklarini aniqlashda hamda sxema ko‘rinishida ifodalashda kuch yo‘nalishlari gorizontal va vertikal o‘qlar kesishgan nuqtada ko‘rsatiladi. Kuch yo‘nalishlari ta’sir qilayotgan tekisligiga perpendikulyar qabul qilinadi.

Fizikaning dinamika qonuni:

$$\sum_{i=1}^{n} \overline{F_i} = \overline{F_1} + \overline{F_2} + \ldots + \overline{F_n} = m\overline{a} \quad (1)$$

bu yerda, M - yukning og‘irlik markazi nuqtasi;

$\overline{F}$- faol kuchlar ($\overline{Q_{yuk}}$, $\overline{F^I}$, $\overline{F^A}$), N;

$\overline{Q}^x_{yuk}$, $\overline{Q}^y_{yuk}$, $\overline{Q}^z_{yuk}$- koordinata o‘qlarida yukning og‘irlik kuchi proyeksiyasi, N;

$$\overline{Q_{yuk}} = m\overline{g} \quad (2)$$

$\overline{F^R}$- qo‘shimcha mahkamlash vositasi (tortqich) ning bog‘lanish reaktivlik (elastiklik) kuchi, N;

$$\overline{F^R} = \overline{N_{kx}} \cdot \bar{i} + \overline{N_{ky}} \cdot \bar{j} + \overline{N} \cdot \bar{k} \quad (3)$$

$\overline{F^K}$- Koriolis inersiya kuchi, N;

$$\overline{F^K} = \overline{F}^K_x \cdot \bar{i} + \overline{F}^K_y \cdot \bar{j} + \overline{F}^K_z \cdot \bar{k} = m \cdot \overline{a_k} \quad (4)$$

$$\overline{a_k} = 2 \cdot \overline{\omega_e} \cdot \overline{v_n} \quad (5)$$

$$\overline{F^K} = 2m\overline{v_r} \times \overline{\omega_e} = 2 \cdot m \cdot \omega_e \cdot v \cdot sin(\overrightarrow{\omega_e}, \vec{v}) \quad (6)$$

Koriolis kuchini hisobga olganda natijaviy tezlanish quyidagi ko‘rinishda bo‘ladi:

$$a = \sqrt{(\frac{dv}{dt})^2 + \frac{v^2}{R} + 4 \cdot (\omega_e \cdot v \cdot sin(\overrightarrow{\omega_e}, \vec{v}))^2} \quad (7)$$

$\overline{v_\tau}$-tangensial yoki nisbiy tezlik, m/s;

$\overline{\omega_e}$- nisbiy burchak tezlik, m/s;

$\overline{F}^K_x$,$\overline{F}^K_y$- Koriolis inersiya kuchi proyeksiyalari, N;

$\overline{F}^I_n$- normal inersiya kuchi, N;

Normal inersiya kuchi va uning tashkil etuvchilarini quyidagicha yozib olish mumkin:

$$F^I_n = \frac{m \cdot v^2}{R} \quad (8)$$

$$F^I_{ny} = F^I_n \cdot cos(\theta + \xi) \quad (9)$$

$$F^I_{nz} = F^I_n \cdot sin(\theta + \xi) \quad (10)$$

$\overline{F^I}$- o‘tkaziladigan inersiya kuchlari;

$$\overline{F^I} = \overline{F}^I_{kix} \cdot \bar{i} + \overline{F}^I_{kiy} \cdot \bar{j} + \overline{F}^I_{kiz} \cdot \bar{k} \quad (11)$$

$\overline{F}^I_x$,$\overline{F}^I_y$,$\overline{F}^I_z$- x,y,z o‘qlarida yukga ta’sir qiluvchi inersiya kuchlari, N;

$\overline{F^A}$- aerodinamik qarshilik kuchi, N;

$\overline{F^A_x}$,$\overline{F^A_y}$,$\overline{F^A_z}$- koordinata o‘qlaridagi aerodinamik qarshilik kuchining proyeksiyalari, N;

$$\overline{F^A} = \overline{F}^A_x \cdot \bar{i} + \overline{F}^A_y \cdot \bar{j} + \overline{F}^A_z \cdot \bar{k} \quad (12)$$

$$W_{shi} = k_i \cdot S_i \quad (13)$$

$$F^{AW}_i = s_1 \cdot \rho_h \cdot \frac{v^2_h}{2} \cdot w_{shi} \quad (14)$$

bu yerda,

k_i- yukning shamol yuzasining uzluksizligini hisobga oluvchi koeffitsient, N;

S_i - shamol ta’sir qiluvchi yuza, m^2;

ρ_h- havoning zichligi ($\rho_h = 1{,}29 kg/m^3$);

v_h- havoning tezligi, m/s;

s_1 -yukning shamol yuzasi shaklini hisobga olgan holda koeffitsient;

X_{F_A}, Y_{F_A}, Z_{F_A}- aerodinamik qarshilik kuchi ta’sir nuqtalari;

$\overline{F^R_{ni}}$- g‘ildirakni mahkamlash vositasi komplektidagi reaktivlik kuchlari, N;

$$\overline{F^R_{ni}} = \sum_{k=1}^{n} \overline{N_k} \quad (15)$$

n - yarim tirkamaning umumiy g‘ildiraklari soni;

k - yarim tirkama g‘ildiraklari raqami;

$\overline{F^R_{nix}}$,$\overline{F^R_{niy}}$- mahkamlash vositasi (tirak to‘sin)ning gorizontal va ko‘ndalang reaksiyasi, N;

Δs - yukning siljishi, m;

$\overline{F_{sh}}$- yarim tirkama shinasining platforma ustida harakatlanishiga to‘sqinlik qiladigan ko‘ndalang kuch, N;

$$F^x_{sh.b} = \mu_{sh} \cdot Q^{yuk}_z \quad (16)$$

$$F^x_{sh} = \mu_\alpha \cdot Q^{yuk}_z \quad (17)$$

$$F^y_{sh.b} = \mu_{sh} \cdot Q_{yuk} \cdot (cos(\theta) \cdot cos(\psi + \upsilon_0) - \frac{a_z}{g}) \quad (18)$$

$$F^y_{sh} = \mu_\alpha \cdot Q_{yuk} \cdot (cos(\theta) \cdot cos(\psi + \upsilon_0) - \frac{a_z}{g}) \quad (19)$$

μ_α- shinalarning yon tomonga sirpanish koeffitsiyenti;

a_z- vertikal nisbiy tezlanish, m/s^2;

$\overline{N_f}$- shina tebranishiga qarshilik kuchi, N;

$$\overline{N_f} = \mu_t \cdot \overline{F_z} \quad (20)$$

μ_t- tebranishga qarshilik koeffitsiyenti ($\mu_t = 0{,}007 \div 0{,}3$);

$\overline{F_{Px}}$- platforma poliga bo‘ylama reaksiya kuchi, N;

$$\overline{F_{Px}} = \overline{N_f} + \overline{F_{ishx}} \quad (21)$$

$\overline{F_{ishx}}$- bo‘ylama yo‘nalishda ishqalanish kuchi, N;

$\overline{F_{Py}}$- platforma poliga ko‘ndalang reaksiya kuchi, N;

$$\overline{F_{Px}} = \overline{F_{sh}} + \overline{F_{ishy}} \quad (22)$$

$\overline{F_{ishy}}$- ko‘ndalang yo‘nalishda sirpanish ishqalanish kuchi, N;

Kuch vektorlarining koordinata o‘qlaridagi proyeksiyalari:

X: $F_x^I - F_x^K - (Q_{yuk}^x + F_x^A) - F_{ix} - N_x - F_{nix}{}^R = ma_{rx} - F_{mqx}$ (23)

Y: $F_y^I + F_y^K + \left(F_{mqy} + F_y^A\right) - Q_{yuk}^y - F_{iy} - N_y - F_{sh} - F_{niy}{}^R = ma_{ry}$ (24)

Z: $-(Q_{yuk}^z - F_z^I) + N - F_{iz} - (F_z^A + F_{mqz}) = ma_{rz}$ (25)

bu yerda,

$F_{mqy} = -m\frac{v_{ry}^2}{R}$ va $F_{mqx} = -m\frac{dv_{\tau x}}{dt}$ dan hamda $\overline{v_\tau} = \overline{v_r}$dan

X: $F_x^I - F_x^K - (Q_{yuk}^x G_x + F_x^A) - F_{ix} - N_x - F_{nix}{}^R = m \cdot (a_{rx} + \frac{dv_{rx}}{dt})$ (26)

Y: $F_y^I + F_y^K - (Q_{yuk}^y - F_y^A) - F_{iy} - N_y - F_{sh} - F_{niy}{}^R = m \cdot (a_{ry} + \frac{v_{ry}^2}{R})$ (27)

Z: $-(Q_{yuk}^z - F_z^I) + N - F_{iz} - (F_z^A + F_{mqz}) = ma_{rz}$ (28)

$\overline{v_r} = const$ dan

X: $F_x^I - F_x^K - (Q_{yuk}^x + F_x^A) - F_{ix} - N_x - F_{nix}{}^R = ma_{rx}$ (29)

Y: $F_y^I + F_y^K - (Q_{yuk}^y - F_y^A) - F_{iy} - N_y - F_{sh} - F_{niy}{}^R = m \cdot (a_{ry} + \frac{v_{ry}^2}{R})$ (30)

Z: $-(Q_{yuk}^z - F_z^I) + N - F_{iz} - (F_z^A + F_{mqz}) = ma_{rz}$ (31)

bunda, ma_{rx}, ma_{ry}, ma_{rz} - koordinata o‘qlaridagi nisbiy inersiya kuchi proyeksiyalari, N;

$\overline{Q}_{yuk} \in (\overline{Q}_{yuk}^x, \overline{Q}_{yuk}^y, \overline{Q}_{yuk}^z)$ - koordinata o‘qlarida yukning og‘irlik kuchi proyeksiyalari, N;

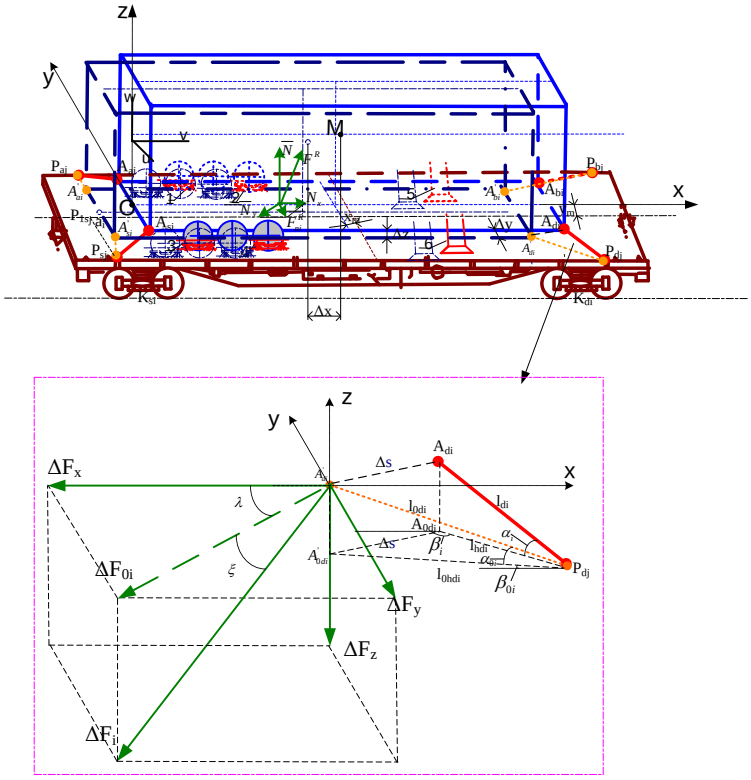
$\overline{F^K} \in (\overline{F}_x^K, \overline{F}_y^K)$ - Koriolis inersiya kuchining o‘qlardagi proyeksiyasi, N;

$\overline{F^I} \in (\overline{F}_x^I, \overline{F}_y^I, \overline{F}_z^I), \overline{F}_n^I$, $\overline{F^A} \in (\overline{F_x^A}, \overline{F_y^A}, \overline{F_z^A})$ - faol kuchlar va ularning o‘qlardagi proyeksiyalari, N;

$\overline{F^{(i)}}, \overline{F}_{sh}, \overline{F^R} \in (\overline{N}, \overline{N}_x, \overline{N}_y)$, $\overline{F_{ni}^R} \in (\overline{F_{nix}^R}, \overline{F_{niy}^R})$ - reaktiv kuchlar va ularning o‘qlardagi proyeksiyalari, N;

Kontreyler tashishlarda avtotransport vositalarini temir yo‘l platformasiga mahkamlashning matematik modelini ishlab chiqish uchun yukning qiyin sharoitlarda harakatlanganida Δs siljish holatini ko‘rib chiqish lozim.

Harakat davomida yo‘lning murakkab sharoitlarida yukning siljish holatlari sodir bo‘ladi (2-rasm).



2-rasm. Yuk siljishining mahkamlash vositasiga ta’siri

Temir yo‘l uchastkalarida yuk poyezdlari uchastka tezliklariga birinchi darajali ($O_{uch.1}$) texnik va texnologik ta’sir ko‘rsatuvchi omillarning qiymatlari PHG bilan muvofiqligi va rejalashtirilganligi sababli shartli ravishda doimiy deb tasniflanadi. Shartli ravishda doimiy ta’sir ko‘rsatuvchi texnik va texnologik omillar uchastka tezliklarining o‘rnatilgan texnik me’yorlari qiymatlarini o‘rnatishda noaniqlik keltirmaydi, biroq ikkinchi darajali ($O_{uch.2}$) ta’sir ko‘rsatuvchi omillar uchastka tezliklarini bajarilish darajasiga ta’sir ko‘rsatadi (2-rasm).

Yuklarga ta’sir qiluvchi kuchlarning yo‘nalishlari va qiymatlari turlicha bo‘lganligi uchun ularning natijaviy ko‘rsatkichlarini aniqlash lozim. Bunda har bir o‘q bo‘yicha ta’sir qiluvchi kuchlar alohida hisoblanadi. Ta’sir qilayotgan nuqtaga perpendikulyar yo‘nalmagan kuchlarni hisoblashda ularni mos o‘qga proyeksiyalash usuli qo‘llaniladi. Bunda ta’sir qiluvchi kuchning o‘qga nisbatan burchagi va yo‘nalishi inobatga olinadi. Turli mahkamlash elementlari va vositalarining turi hamda sonini tanlash uchun ularga tushuvchi siljitish kuchlarini aniqlash kerak.

Mahkamlash elementining tashqi kuch ta’sirida uzayishi:

$$\Delta l_i = \Delta s \cdot (\cos\alpha_i \cdot \cos\beta_{oi} \cdot \cos\lambda^{(i)} + \cos\alpha_i \cdot \sin\beta_{oi} \cdot \sin\lambda^{(i)} + \sin\alpha_i) \cdot \cos\varepsilon^{(i)} \quad (32)$$

bunda,

$$\cos(\overline{\Delta F^{oi}}, \overline{\Delta F^{i}}) = \frac{\Delta F^{oi}}{\Delta F^{i}} \text{ yoki } \cos\varepsilon = \frac{\Delta F^{oi}}{\Delta F^{i}} \quad (33)$$

Mahkamlash elementining proyeksiyasidan:

$$\Delta l_i = \Delta s \cdot (\frac{a_i}{l_i} \cdot \cos\lambda^{(i)} + \frac{b_i}{l_i} \cdot \sin\lambda^{(i)} + \frac{h_i}{l_i}) \cdot \cos\varepsilon^{(i)} \quad (34)$$

bunda,

a_i, b_i, h_i- tortqichning bo‘ylama, ko‘ndalang va vertikal koordinata o‘qlaridagi uzunliklari, m;

$\lambda^{(i)}$, $\varepsilon^{(i)}$- kuchlar fazoviy tizimlarining yo‘nalishlarini tavsiflovchi burchaklar, °;

Guk qonuniga asosan mahkamlash vositasining zo‘riqish kuchi:

$$F_i^R = k \cdot \Delta l_i \quad (35)$$

$$k = \frac{E \cdot S}{l_0} \quad (36)$$

$$S = \pi \cdot R^2 = \pi \cdot \frac{d^2}{4} \quad (37)$$

(37) dan (36) ning ko‘rinishi quyidagicha bo‘ladi:

$k = \frac{\pi}{4} \cdot \frac{E}{l_0} \cdot d^2$ ekanligidan po‘lat sim uchun

$$F_i^R = \frac{\pi}{4} \cdot E \cdot d_i^2 \cdot \frac{n_i}{l_i} \cdot \Delta l_i \quad (38)$$

bu yerda, k - tortqichning deformatsiyasini xarakterlovchi bikrlik, N/m;

π - 3,14

E - Yung moduli (po‘lat uchun 190-210 Gpa);

F_i^R- zo‘riqish kuchi (kN);

n_i va d_i- tortqichdagi simlarning soni va mahkamlash simining diametri, m;

$l_i = l_0$- moslashuvchan mahkamlash vositasi (tortqich) ning boshlang‘ich uzunligi, m;

(34), (38) dan Δs siljishdagi zo‘riqish kuchi:

$$F_i^R = \Delta s \cdot \frac{\pi}{4} \cdot E \cdot d_i^2 \cdot \sum_{i=1}^{n_p} \frac{n_i}{l_i} \cdot (\frac{a_i}{l_i} \cdot \cos\lambda^{(i)} + \frac{b_i}{l_i} \cdot \sin\lambda^{(i)} + \frac{h_i}{l_i}) \cdot \cos\varepsilon^{(i)} \quad (39)$$

(39) ga qo‘llash orqali:

$$\Delta s \cdot \frac{\pi}{4} \cdot E \cdot d_i^2 \cdot \sum_{i=1}^{n_p} \frac{n_i}{l_i} \cdot (\frac{a_i}{l_i} \cdot \cos\lambda^{(i)} + \frac{b_i}{l_i} \cdot \sin\lambda^{(i)} + \frac{h_i}{l_i}) \cdot \cos\varepsilon^{(i)} \times \times \sqrt{(\frac{a_i}{l_i} + \mu_{sh} \cdot \frac{h_i}{l_i} \cdot \cos\lambda)^2 + (\frac{b_i}{l_i} + \mu_{sh} \cdot \frac{h_i}{l_i} \cdot \sin\lambda)^2 + \frac{h_i}{l_i}^2} = \Delta F_i \quad (40)$$

Ta’sir kuchi yo‘nalishida yukning siljishi:

$$\Delta s = \frac{\Delta F_i}{c_{ekv}^F} \quad (41)$$

c_{ekv}^F- ta’sir kuchi yo‘nalishi bo‘yicha yarim tirkamaning egiluvchan simli nahkamlagichlari va elastik vositalarning ekvivalent qattiqligi;

(41) ifoda orqali mahkamlash vositasining ekvivalent qattiqligini quyidagicha ifodalash mumkin:

$$c_{ekv}^F = \frac{\pi}{4} \cdot E \cdot d_i^2 \cdot \sum_{i=1}^{n_p} \frac{n_i}{l_i} \cdot (\frac{a_i}{l_i} \cdot \cos\lambda^{(i)} + \frac{b_i}{l_i} \cdot \sin\lambda^{(i)} + \frac{h_i}{l_i}) \cdot \cos\varepsilon^{(i)} \times \times \sqrt{(\frac{a_i}{l_i} + \mu_{sh} \cdot \frac{h_i}{l_i} \cdot \cos\lambda)^2 + (\frac{b_i}{l_i} + \mu_{sh} \cdot \frac{h_i}{l_i} \cdot \sin\lambda)^2 + \frac{h_i}{l_i}^2} \quad (42)$$

Yarim tirkamani mahkamlash mustahkamligi uchun:

$$F_i^{Rel} = \Delta s \cdot \frac{\pi}{4} \cdot E \cdot d_i^2 \cdot \sum_{i=1}^{n_p} \frac{n_i}{l_i} \cdot (\frac{a_i}{l_i} \cdot \cos\lambda^{(i)} + \frac{b_i}{l_i} \cdot \sin\lambda^{(i)} + \frac{h_i}{l_i}) \cdot \cos\varepsilon^{(i)} \le [F_i^R] \quad (43)$$

bu yerda,

$[F_i^R]$ - mahkamlashda ruhsat etilgan zo‘riqish qiymati, N;

$$\Delta s_x = \frac{\Delta F_{ix}}{c_{ekvx}^F} \quad (44)$$

$$\Delta s_y = \frac{\Delta F_{iy}}{c_{ekvy}^F} \quad (45)$$

$$\Delta s_z = \frac{\Delta F_{iz}}{c_{ekvz}^F} \quad (46)$$

Siljish qiymati:

$$\Delta s = \sqrt{(\Delta s_x)^2 + (\Delta s_y)^2 + (\Delta s_z)^2} \quad (47)$$

bu yerda,

Δs_x, Δs_y, Δs_z- yukning bo‘ylama, ko‘ndalang va vertikal siljishi, m;

Olingan formula kontreyler tashishlarda avtotransport vositasini platformaga mahkamlash texnologiyasining yanada aniqroq, xavfsiz va ishonchli tanlash imkonini beradi.

4. Xulosa

Temir yo‘l platformasiga ortilgan yarim tirkama uchun ishlab chiqilgan matematik model yordamida mahkamlash vositasining mustahkamligi chegarasini inobatga olib, yukning siljish masofasi, mahkamlash vositasi (tortqich) ning umumiy soni, simlari soni, simning diametri va qattiqlik darajasiga asosan materilini tanlash imkoniyati mavjud.

Bunda poyezdning harakat tezligi 5 m/s bo‘lganida tortqichga ta’sir etuvchi kuch 100,1 kN, tezlik 15 m/s bo‘lganida kuch 100,3 kN, 25 m/s bo‘lganida kuch 100,9 kN bo‘lishi yarim tirkama uchun aniqlandi. 2-rasmda esa mahkamlash vositalari ortishi yukning siljish masofasini kamayishiga olib kelishi ko‘rsatilgan. Bunda mahkamlash vositalarining soni 2 ta bo‘lganida siljish masofasi 30 mm, 3 ta bo‘lganida siljish masofasi 20 mm, 4 ta bo‘lganida siljish masofasi 15 mm atrofida bo‘lishi olindi.

Olingan formula va blok-sxema kontreyler tashishlarda avtotransport vositasini platformaga mahkamlash texnologiyasining yanada aniqroq, xavfsiz va ishonchli tanlash imkonini beradi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Adilova (Muxamedova) Ziyoda Gafurdjanovna	Toshkent davlat transport universiteti “Yuk transport tizimlari” kafedrasi professori. t.f.d (DSc), E-mail: mziyoda@mail.ru Tel.: +99890 3298300 https://orcid.org/0000-0002-1825-2447
Boboyev Diyor Shomurotovich	Toshkent davlat transport universiteti “Yuk transport tizimlari” kafedrasi assistenti. t.f.f.d (PhD). E-mail: diyor1803boboyev@gmail.com Tel.: +99890 4141803 https://orcid.org/0000-0003-0785-2209
Axtamov Navruz Baxtiyorovich	Toshkent davlat transport universiteti “Yuk transport tizimlari” kafedrasi tayanch doktoranti. E-mail: axmatov.navruz@bk.ru Tel.: +99894 6206166 https://orcid.org/0009-0004-8987-961X

Problems caused by the impact of heavy trucks on the surface of asphalt concrete pavements

A.X. Urokov[1][a], E.T. Ashurov[2][b], U.B. Bekmurodov[2]
[1]Tashkent state transport university, Tashkent, Uzbekistan
[2]Termez state of engineering and agrotechnologies university, Termez, Uzbekistan

Abstract: Analysis of the current condition of the 1400-1426 km section of the M-39 "Almaty-Bishkek-Tashkent-Shahrisabz-Termiz" highway in the southern region of our republic shows that the heavy load on the road surface and bridge surfaces is caused by vehicles. There are a number of structural problems and deficiencies in the load-bearing capacity of the road surface, and there are a number of structural problems and defects in the road surface.
Keywords: Heavy load, asphalt concrete pavement, transport, displacement, wheel track, deformation, defect

Asfaltbeton qoplamalari yuzasida og‘ir yuk avtomobillarining tasiri natijasida vujudga kelgan muammolar

Urokov A.X.[1][a] , Ashurov E.T. [2][b] , Bekmurodov U.B. [2]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston
[2]Termiz davlat muhandislik va agrotexnologiyalar universiteti, Termiz, O‘zbekiston

Annotatsiya: Respublikamizning janubiy hududidagi M-39 “Almata-Bishkek-Toshkent-Shahrisabz-Termiz" avtomobil yo‘lining 1400-1426 km qismining hozirgi holatidagi taxlilar shuni ko‘rsatadiki, yo‘l qoplamasi va ko‘prik qoplamalariga og‘ir yuk transport vositalaridan tushadigan yuklamalar ta’sirida bo‘ylama noravonliklar, deformatsiya, buzilishlar, qoplamaning yuk ko‘tarish qobiliyatidagi bir qator tizimli muammolar va kamchiliklar yuzaga kelmoqda. Natijada, avtomobil yo’llarining belgilangan xizmat muddatini ta’minlanmasligi, yo‘l qoplamasida ko‘p sonli deformatsiya va buzilishlar, nuqsonlar paydo bo‘lishi yo‘l harakati xavfsizligiga katta ta’sir ko ‘rsatmoqda.
Kalit so‘zlar: Og‘ir yuk, asfaltbeton qoplama, transport, siljish, g‘ildirak izi, deformatsiyalar, nuqson

1. Kirish

Mamlakatimizda amalga oshirilayotgan islohotlar natijasida umumiy foydalanishdagi avtomobil yo‘llari, shahar ko‘chalari va ichki xo‘jalik yo‘llarini, ko‘prik va boshqa sun’iy inshootlarni qurish, rekonstruksiya qilish va ta’mirlash ishlari amalga oshirildi. Respublikada transport logistikasi sohasini rivojlantirish va tranzit salohiyatini oshirish, hamda transport sohasida keng ko‘lamli amalga oshirilayotgan bunyodkorlik ishlari hisobiga amaldagi 25 tonna va undan ortiq yuk ko‘tarish qobiliyatiga ega uch, to‘rt va undan ko‘p o‘qli avtotransport vositalarining importi sezilarli darajada ko‘paydi. Bugungi kunda avtomobil yo ‘llarida katta hajmli va og‘ir vaznli avtotransport vositalarining harakat jadalligi oshib borayotgan bir vaqtda ularning vazn va hajm parametrlarini nazorat qilish to‘liq tartibga solinmaganligi hamda ushbu yo‘nalishda avtomatlashtirilgan tizimlarni qo‘llanilmayotganligi sababli, yo‘llarni saqlanganligini ta’minlashda bir qator muammolar yuzaga kelmoqda, xususan avtomobil yo‘llari, ko‘priklar va yo‘l o‘tkazgichlarning ta’mirlashlararo va xizmat qilish muddatlarini qisqarishi va ekspluatatsiya xarajatlarini ortishi, yo‘llarda bo‘ylama va ko‘ndalang noravonliklarini yuzaga kelishi, ushbu yo‘l bo‘laklarida harakat tezligini pasayishi va harakatning xavflilik darajasini ortishi . Ekspluatatsiya davrida avtomobil yo‘llari qoplamalarining jadal deformatsiyalanishi va buzilishning sabablaridan biri - ularning ishlash sharoitlarini o‘zgarishidir. Yuqori havo haroratida yo‘lning asfaltbeton qoplamasi harorati yuqori bo‘ladi, natijada asfaltbeton tarkibidagi bitum bog’lovchisining yumshashi oqibatida uning elastiklik modulini kamayishi kuzatiladi.

2. Tadqiqot metodikasi

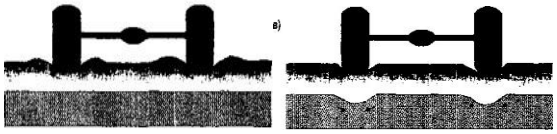
Yozgi hisobiy davrda asfaltbeton qoplamasining elastiklik modulini kamayishi davrida transport oqimining miqdor va sifat jihatdan o‘zgarishi natijasida og‘ir yuk transport vositalarining o‘qiga tushadigan yuklamasini ortib borishi hisobiga yo‘l qoplamasining ko‘ndalang noravonliklarini yuzaga kelishi, shuningdek harakat tezligi pasayishi yuzaga keladi [1].

[a] https://orcid.org/0000-0001-8404-3013
[b] https://orcid.org/0009-0007-2900-0046

Asfaltbeton qoplamalarda ko‘p yuzaga keladigan muammolar quyidagilar hisoblanadi: yoriqlar, o‘yiqlar, cho‘kishlar, siljishlar, g‘ildirak izlari. Bugungi kunda bunday nuqsonlarning paydo bo‘lishiga transport oqimida hisobiy avtomobillarda belgilangan bitta o‘qqa tushadigan hisibiy yukdan yuqori bo’lgan og‘ir yuk abtomobillarining sonini keskin ko‘payib borayotganligi sabab bo‘lmoqda [2]

Qoplamalarga transport vositalaridan va tabiiy-iqlim omillardan tushadigan zo‘riqishlar ruxsat etilgan me’yorlardan ortib ketganda qoplama deformatsiyalanadi. Yilning turli fasllarida havo haroratining o‘zgarishlari, qoplamalarda muzlash-erish jarayonlarining kechishi natijasida asfaltbeton qoplamalarda kuchlanishlar hosil bo‘ladi. Asfaltbeton qoplama elastik-plastik material bo‘lganligi, qizish sovish jarayonlarda xususiyatlari o‘zgarishi, mo‘rt holatdan plastik holatga o‘tishi sabablaridan plastik deformatsiyalar yuzaga keladi. Bunda qoplamaning deformatsiyaga bardoshliligi turli yuklamalarning ta‘sir etish davomiyligiga bog‘liq bo‘ladi. Yilning issiq vaqtlarida qoplama harorati ancha ko‘tarilib asfaltbeton yumshab qoladi va transport vositalari ta’sir etganidan qoldiq deformatsiyalar to‘planib qoladi [1].

Qoplama yuzasida ishlash jarayonida turli xil deformatsiyalar, jumladan g‘ildirak izi deformatsiyasi hosil bo‘ladi (1-rasm).



1– rasm. Qoplamada g‘ildirak izi shakllanishining asosiy sxemalari: a) yuzaki g‘ildirak izi; b) pastki qatlamlarda xam hosil bo‘luvchi g‘ildirak izi.

Respublikaning janubidagi Surxondaryo viloyatidan o‘tadigan xalqaro ahamiyatdagi “M-39 “Almata-Bishkek-Toshkent-Shahrisabz-Termiz” avtomobil yo‘lining 1330-1451km (121 km) bo‘lagini rekonstruktsiya qilish loyihasi xalqaro sarmoyalar hisobidan bajarildi. Hozirgi kunda ushbu yo‘l bo‘lagidan o‘tadigan transport oqimi tarkibida yuqori dinamik xususiyatlarga ega bo‘lgan xorijiy rusumdagi avtomobillarni harakat jadalligi ortib bormoqda. Ushbu hududlarda Sherabodsement zavodi hamda Sherabod qurilish materiallari ishlab chiqaruvchi karerlar joylashgan bo‘lib, ularda tashilayotgan yuk miqdorlarining belgilangan o‘qqa tushadigan yuklama me’yoridan yuqori ekanligi aniqlandi.

Katta hajmli va og‘ir vaznli yuklarni avtomobil transportida tashish Vazirlar Mahkamasining 2011 yil 26 dekabrdagi 342-son qaroriga asosan quyidagicha:

Avtotransport vositalarining ruxsat etilgan massasi ko‘rsatgichlari

1-jadval

Transport vositasi turi	Ko‘rsatkich (t)
Yakka avtotransport vositalari:	
ikki o‘qli	18
uch o‘qli	26
to‘rt o‘qli	32
Mingashmali va tirkamali avtopoezdlar:	
uch o‘qli	28
to‘rt o‘qli	36
besh o‘qli	40
olti va undan ortiq o‘qli	44

Umumiy foydalanishdagi avtomobil yo‘llari yo‘l to‘shamasining mustahkamligini hisoblashda avtomobilning eng ko‘p yuklangan yakka o‘qidagi og‘irlik I-II toifa uchun 130 kN (13 t), III-V toifa uchun 100 kN (10 t) qabul qilingan [3]. Respublikamizdagi ko‘pgina avtomobil yo‘llaridagi yo‘l to‘shamasiga tushadigan og‘irlik ushbu me’yoriy qiymatlardan oshib ketgan holatlar ko‘p uchraydi.

Xalqaro ahamiyatdagi M39 “Almata-Bishkek-Toshkent-Shahrisabz-Termiz” avtomobil yo‘lini Surxondaryo viloyatidan o‘tadigan bo‘lagini rekonstruktsiyadan keyin foydalanishga topshirilmasdan (qoplama yotqizilganiga 3 yil bo‘lgan) ushbu yo‘l bo‘lagida ko‘p sonli deformatsiya va buzilishlar: yoriqlar, o‘yiqlar, cho‘kishlar, siljishlar, g‘ildirak izlari, yo‘l qoplamasining bo‘ylama va ko‘ndalang noravonliklar va buzilishlar yuzaga kelishi kuzatilmoqda. Bunday nuqsonlarni paydo bo‘lishini bartaraf etish, avtomobil yo‘lining zarur transport-ekspluatatsion ko‘rsatkichlarini uzoq muddatli saqlashni ta‘minlash, yo‘l qoplamasining yaxlitligini saqlash va xizmat muddatini oshirishga yordam beradigan samarali yechimlar topish maqsadida M39 “Almata-Bishkek-Toshkent-Shahrisabz-Termiz” avtomobil yo‘lining 1395-1420 km qismlarida kuzatuv ishlari olib borildi (2-rasm).

2– rasm. M-39 “Almata-Bishkek-Toshkent-Shahrisabz-Termiz” avtomobil yo'lining 1398-1420 kmlarda qoplama g‘ildirak izi va siljish deformatsiyalar

Bugungi kunda og‘ir yuk avtomobillarini ko‘payib ketishi me’yordan ortiq yuk ortishi oqibatida qoplamaga jiddiy zarar yetkazmoqda. Yo‘l qoplamalarida g‘ildirak izini paydo bo‘lishi hamda ko‘prik qoplamalarini siljishi ortidan foydalanishga topshirilmasdan (qoplama yotqizilganiga 3 yil bo‘lgan), bugungi kunga kelib yo‘l bo‘lagi qoplamasi qayta ta’mirlanmoqda.

Ushbu buzulishlar sababini tadqiq qilish maqsadida «Sherabod yo‘llardan foidalanish» unitar korxonasi mutaxassislari 2023 yil sentabr oyida xalqaro ahamiyatga molik M39 «Almati-Bishkek-Toshkent-Shahrisabz-Termiz» avtomobil yo‘lining 1402 kilometrida “Sherabod-Termiz” yo‘nalishida og‘ir yuk transport vositalarining vazn va hajm o‘lchamlarini nazorat qilish mobil tarozi ishga tushirildi.

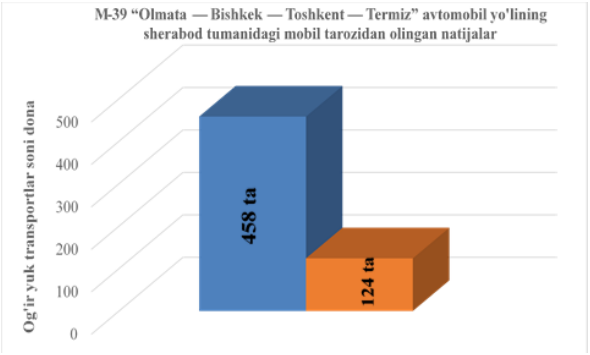
Og‘ir yuk transport vositalari nazorat qilinganda ortiqcha vazn yuk bilan harakatlanayotgan transport vositalari aniqlandi (2-jadval).

3– rasm. M-39 “Almata-Bishkek-Toshkent-Shahrisabz-Termiz” avtomobil yo'lining 1402 kmda og‘ir yuk transport vositalarining vaznini TENZO mobil tarozida o‘lchov ishlari

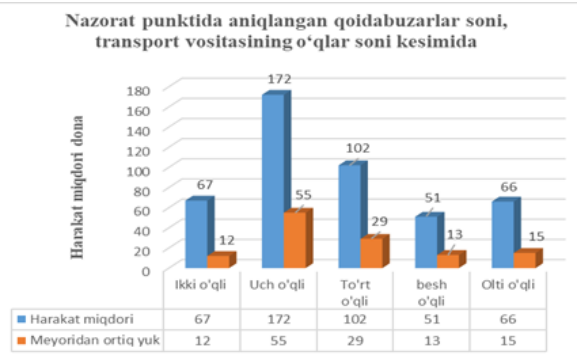
2-jadval

M-39 “Almata-Bishkek-Toshkent-Shahrisabz-Termiz” avtomobil yo‘lining 1395-1420 kmlarida mobil tarozi nazorat punkitlar

№	Sana va vaqt	Og‘ir yuk avtomobillarni o‘qlar soni						Umumiy og‘irlik (т)	Ortiqcha og‘irlik yuk (т)	Foto
		1-o‘qli (т)	2-o‘qli (т)	3-o‘qli (т)	4-o‘qli (т)	5-o‘qli (т)	6-o‘qli (т)			
1.	13.11.2023 Soat 08:44	8.50	14.02	13.05	17.43	11.91	10.52	75.43	11.43	
2.	13.11.2023 Soat 09:04	7.08	18.71					25.79	7.79	
3.	14.11.2023 Soat 09:29	8.19	18.90	18.76				45.85	19.85	
4.	23.12.2023 Soat 09:41	9.41	20.85	20.30				50.56	24.56	
5.	16.01.2024 Soat 10:52	6.30	17.23					23.53	5.53	
6.	16.01.2024 Soat 10:58	7.17	18.21					25.38	7.38	
7.	16.01.2024 Soat 11:01	9.29	18.82	17.97				46.08	20.08	
8.	16.01.2024 Soat 11:25	6.87	18.75	17.62				43.24	17.24	
9.	22.01.2024 Soat 11:37	5.57	13.77					19.34	1.34	
10.	22.01.2024 Soat 12:11	7.80	14.77	14.75				37.32	11.32	
11.	1002.2024 Soat 09:30	8,37	14,2	13,64	13,49	13,28	15,66	78,64	34, 64	
12.	10.02.2024 Soat 11:18	6,79	8,55	7,98	4,96	10,06	9,94	48,28	4,28	
13.	04.03.2024 Soat 11:30	7,58	12,42	11,9				31,9	5.9	
14.	04.03.2024 Soat 11:42	7,14	12,31	6,92	7,17			33,54	1.54	



4-rasm. Nazorat punktida aniqlangan qoidabuzarlar soni



5-rasm. Nazorat punktida aniqlangan qoidabuzarlar transport vositasining o‘qlar soni kesimida

M-39“Almata-Bishkek-Toshkent-Shahrisabz-Termiz” avtomobil yo‘lining 1402 kmda og‘ir yuk transport vositalarining vaznini Sherabod tumanida joylashgan mobil TENZO nazorat tarozisidan 2023 yil oktabr oyidan 2024 yil mart oyiga qadar umumiy nazoratdan o‘tgan og‘ir transport vositasining soni 458 ta bo‘lib, meyyordan ortiq yuklangan transport vositalari 124 dona (27 %) ni tashkil etdi.

3. Xulosa

Xalqaro ahamiyatdagi avtomobil yo‘llarining transport-ekspluatatsion sifatlarini oshirish, viloyatlar oralig‘ida ishonchli transport muhitini tashkil qilish, tranzit aloqani yaxshilash maqsadida M-39 “Almata-Bishkek-Toshkent-Shahrisabz-Termiz” avtomobil yo‘lining saqlanganligini ta’minlash muhim hisoblanadi. Yuqorida keltirilgan tadqiqotlardan ma’lum bo‘ladiki, me’yordan ortiq vaznli transport vositalari harakatlanishi davomida asfaltbeton qoplamali avtomobil yo‘llarida g‘ildirak izi deformatsiyasini hosil bo‘lishi jadallashib bormoqda.

Natijalari shuni ko‘rsatadiki og‘ir yuk avtomobillaridan tushadigan yuklar yo‘l qoplamasini xizmat qilish muddatini kamaytiradigan eng asosiy omillardan biri bo‘lmoqda. 2023 yil oktabr, noyabr, dekabr, 2024 yil yanvar, fevral, mart oylarida tadqiqot o‘tkazildi. Tadqiqotlar natijasiga ko‘ra quydagilar aniqlandi:

- Og‘ir yuk avtomobilidan tushayotgan eng kam ortiqcha yuk 1.01 tonna
- Og‘ir yuk avtomobilidan tushayotgan eng ko‘p ortiqcha yuk 34.64 tonna
- Og‘ir yuk avtomobilidan tushayotgan ortacha og‘ir yuk 10.71 tonna

Shu o‘rnida aytish mumkinki, mamlakatimiz hududida iqlim sharoiti tez o‘zgaruvchan bo‘lganligi uchun yoz kunlarida janubiy hududlarda harorat (Termiz) 46 °C ga teng. Surxondaryo viloyati mamlakatimizni eng issiq hududlaridan biri bo‘lganini inobatga olgan holda yo‘llarni saqlash hamda xizmat qilish muddatini uzaytirishga quydagi takliflarni berib o‘tamiz:

- og‘irlik va gabarit parametrlarini nazorat qilishning avtomatlashtirilgan o‘lchov tizimlari bilan jihozlangan og‘irlik va gabarit nazorati bo‘yicha statsionar shoxobchalarni o‘rnatish;
- yuqori haroratli iqlim sharoitlarda havo harorati 40 oC dan o‘tgandan so‘ng og‘ir yuk avtomobillar harakatini vaqtincha cheklash;
- asfaltbeton qoplamali yo‘llarda g‘ildirak izi deformatsiyasini keltirib chiqaruvchi omillarni oldini olish;
- bog‘lovchi yo‘l qurilish materiallarni yuqori haroratga chidamliligini oshirish;

avtomobil yo‘llarini qurishda, qurish texnologiyasini to‘g‘ri tashkil qilinishini nazorat qilish.

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[2] Abdunazarov, A., & Sharofitdin, Y. (2023). Yer osti suvlari sathining seysmik sirt to‘lqinlari tarqalishiga ta’siri.

[3] Abdunazarov, A., & Sharofitdin, Y. (2023). Binoga ta’sir etayotgan seysmik sirt to‘lqinlarining grunt xususiyatiga bog’liqligi.

Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Urakov Asliddin Xushvaqtovich	Toshkent davlat transport universiteti “Yo‘l muhandisligi” fakulteti t.f.d. prof, Tel.: +998977842608
Ashurov Elyor To‘lqinovich	Termiz davlat muhandislik va agrotexnologiyalar universiteti “Yo‘l muhandisligi” kafedrasi assistenti. E-mail: elyor.ashurov.2015@mail/ru Tel.: +998902473390
Bekmurodov Umid Bekmurodovich	Termiz davlat muhandislik va agrotexnologiyalar universiteti “Yo‘l muhandisligi” kafedrasi assistenti. E-mail: umidbekmurodov.2021@gmail/ru Tel.: +99886920987

Modern state and prospects of high-speed passenger train movement on the railways of Uzbekistan

R.Sh. Bozorov[1][a], S.B. Sattorov[1][b], Sh.U. Saidivaliev[1][c], D.Sh. Boboev[d], Z.V. Ergasheva[1][e]

[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: This article analyzes the existing technology of moving trains of various categories on high-speed highways, as well as the current state and prospects for the organization of high-speed train traffic on the railways of the Republic. The main usage indicators of the Uzbekistan-Khovos section, where there are different types of train traffic, were analyzed, the times of freight trains at intermediate stations in order to pass high-speed passenger trains and the total number of stops were determined.

Keywords: High speed, freight train, dwell time, number of stops, usage figures, section speed, technical speed

O‘zbekiston temir yo‘llarida yuqori tezlikdagi yo‘lovchi poezdlari harakatini taskil etishning zamonaviy holati va istiqbollari

Bozorov R.Sh.[1][a], Sattorov S.B.[1][b], Saidivaliyev Sh.U.[1][c], Boboev D.Sh.[1][d], Ergasheva Z.V.[1][e]

[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Ushbu maqolada yuqori tezlikdagi magistrallarda turli toifadagi poezdlarni o‘tkazishning mavjud texnologiyasi shuningdek, Respublika temir yo‘llarida yuqori tezlikdagi poezdlar harakatini tashkil etishning hozirgi holati va istiqbollari tahlil qilingan. Turli toifadagi poezdlar harakati mavjud bo‘lgan “O‘zbekiston-Xovos” uchastkasining asosiy foydalanish ko‘rsatkichlari tahlil qilindi, yuk poezdlarini yuqori tezlikdagi yo‘lovchi poedlarini o‘tkazib yuborish maqsadida oraliq stansiyalarida turish vaqtlari va umumiy to‘xtab turishlar soni aniqlab olindi.

Kalit so‘zlar: Yuqori tezlik, yuk poezdi, turish vaqti, to‘xtab turishlar soni, foydalanish ko‘rsatkichlari, uchastka tezlik, texnik tezlik

1. Kirish

Respublikamizning turistik salohiyati va jozibadorligini oshirish bo‘yicha qo‘llanilayotgan chora-tadbirlar natijasida 2022 yilda xorijdan sayyohlik maqsadida tashrif buyurgan turistlar soni 2021 yilga nisbatan 3,1 marta ortgan shuningdek, turizm xizmatlari eksporti 2021 yilda 422,1 mln. AQSh dollarini tashkil etgan bo‘lsa, 2022 yilda bu ko‘rsatkich 1,6101 mlrd. AQSh dollariga yetgan. Kelgusida sayyohlar sonini 20 mln.gacha yetkazish ko‘zda tutilmoqda. Ularni respublikamizning ko‘hna turizm ob’ektlariga yuqori darajadagi servis xizmatlarini ko‘rsatgan holda yetib borishini ta’minlash maqsadida tezyurar va yuqori tezlikdagi yo‘lovchi poezdlari qatnovi ko‘lamini kengaytirish yuzasidan ko‘plab sa’y-harakatlar amalga oshirilishini taqozo etadi. Xususan, 2022-2026 yillarga mo‘ljallangan Yangi O‘zbekistonning taraqqiyot strategiyasida barcha transport turlarini uzviy bog‘lagan holda yagona transport tizimini rivojlantirish, shaharlararo va shahar atrofi temir yo‘l qatnovlari jozibadorligini oshirish, shuningdek temir yo‘l infratuzilmasini elektrlashtirish darajasini 60 foizga yetkazish orqali temir yo‘l transportini jadal rivojlantirish maqsad sifatida belgilab qo‘yildi [1]. Yaqin kelajakda tezyurar va yuqori tezlikdagi yo‘lovchi poezdlari qatnovi ko‘lamining kengayishi temir yo‘llarda rekonstruktiv tadbirlarni amalga oshirish, qo‘shimcha yo‘llarni qurish va ularni elektrlashtirish ehtiyojini yuzaga keltiradi. Ungacha bo‘lgan davrda esa yuqori tezlikdagi magistrallarida mavjud texnik va texnologik imkoniyatlardan to‘liq foydalangan holda poezdlar harakatini samarali tashkil etish texnologiyalarini ishlab chiqish va amalga tatbiq qilish maqsadga muvofiq.

[a] https://orcid.org/0000-0001-8655-0764
[b] https://orcid.org/0000-0001-7273-0449
[c] https://orcid.org/0000-0002-4461-4093
[d] https://orcid.org/0000-0003-0785-2209
[e] https://orcid.org/0000-0003-1651-0892

2. Adabiyotlar tahlili va metodologiyasi

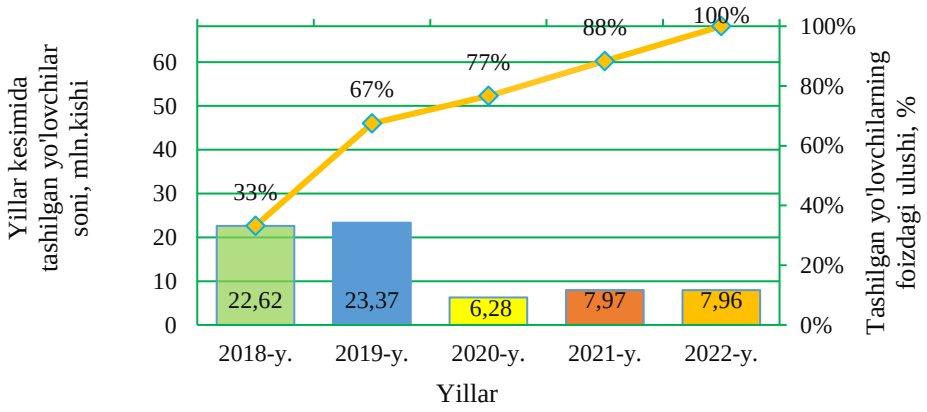
Hozirgi kunda “O‘zbekiston temir yo‘llari” AJ temir yo‘l tarmog‘ining umumiy uzunligi 7500 km atrofida, bundan 3528,1 kmdan ortiq yo‘llar elektrlashtirilgan. 731,9 km (10 %) uzunlikdagi yo‘llarda 160 km/soatgacha, 243,5 km (3 %) uzunlikdagi yo‘llarda esa 250 km/soatgacha tezlikda poezdlarning harakatlanishi imkoniyati yaratilgan (1-rasm). Bu yo‘llarda tezyurar “Sharq”, “Nasaf” va yuqori tezlikdagi “Afrosiyob” elektrpoezdlar harakatlanmoqda [1-3].

Respublikamizda 2011 yilda “Afrosiyob” yuqori tezlikdagi yo‘lovchi poezdlari harakati avval Toshkent-Samarqand yo‘nalishida, keyinchalik Toshkent-Buxoro va Toshkent-Qarshi yo‘nalishlarida yo‘lga qo‘yilgan. Yaqin kelajakda Buxoro-Miskin va Urganch-Xiva yangi temir yo‘l uchastkalarini elektrlashtirish ishlari to‘liq yakuniga yetgach, bu poezdlar sonini 10 tadan ziyodga oshirish mo‘ljallangan.

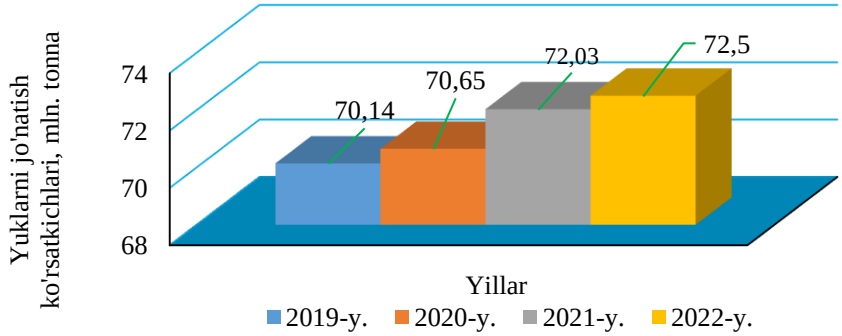
1-rasm. “O‘TY” AJ temir yo‘l tarmog‘ida belgilangan harakat tezliklari ulushi

Umuman olganda, har hafta respublika temir yo‘l vokzallaridan 84 juft yo‘lovchi poezdlari harakatlanadi. Yuqori tezlikdagi yo‘lovchi poezdlaridan tashqari uzoqqa qatnovchi, mahalliy va shahar atrofi yo‘lovchi poezdlari quyidagi yo‘nalishlarda harakatlanmoqda: Toshkent-Termiz, Toshkent-Xiva, Toshkent-Shovot, Qumqo‘rg‘on-Sariosiyo, Toshkent-Buxoro, Toshkent-Qo‘ng‘irot, Toshkent-Andijon, Andijon-Buxoro, Andijon-Xiva, Andijon-Termiz va h.k. [2].

“O‘TY” AJning biznes rejasiga asosan oxirgi to‘rt yil mobaynida temir yo‘l transporti orqali tashilgan yo‘lovchilar soni va jo‘natilgan yuklar miqdori quyidagicha bo‘ldi (2- va 3-rasmlar).



2-rasm. Temir yo‘l transporti orqali tashilgan yo‘lovchilar soni

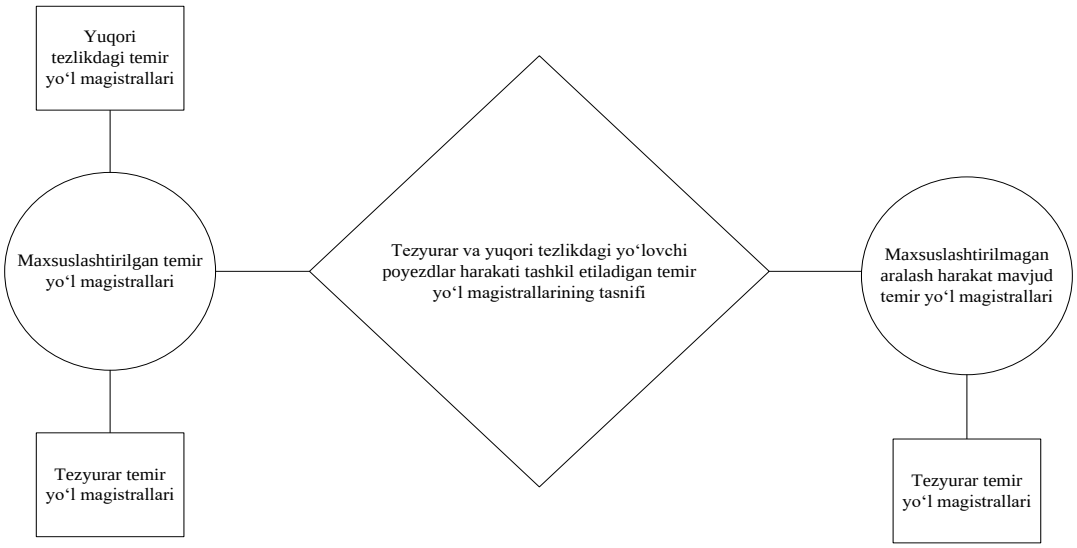


3-rasm. Temir yo‘l transporti orqali jo‘natilgan yuklar miqdori

Yuqori tezlikdagi yo‘lovchi va yuk poezdlari sonining hamda yo‘lovchi poezdlari tezligining ortish sharoitida turli toifadagi poezdlarning mavjud uchastkalardan samarali o‘tkazish vazifasi dolzarb hisoblanadi. “O‘TY” AJda yo‘lovchi poezdlarining harakatlanish tezligi bo‘yicha uchastkalar turli toifalarga ajratilgan. Xususan, O‘zbekiston Respublikasi temir yo‘llaridan texnikaviy foydalanish Qoidalariga muvofiq temir yo‘l uchastkalari quyidagi turlarga ajratilgan:

- 140 km/soatgacha tezlikda-oddiy temir yo‘llar;
- 141 dan 160 gacha va 161 dan 200 km/soatgacha oraliqdagi tezliklarda - tezyurar magistrallar;
- 201-250 km/soat oraliqdagi tezliklarda - yuqori tezlikdagi magistrallar.

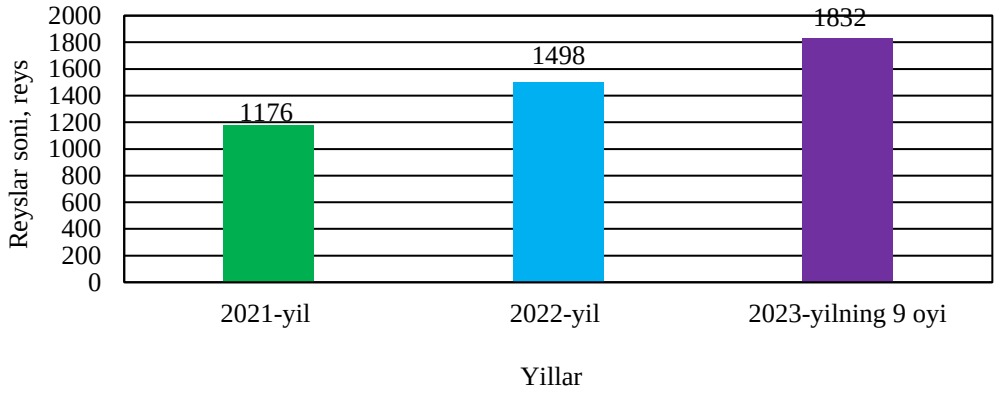
Yuqori tezlikdagi yo‘lovchi poezdlari harakatini tashkil etishda jahon tajribasiga asosan temir yo‘l magistrallari quyidagicha tasniflangan (4-rasm) [1-5]:



4-rasm. Tezyurar va yuqori tezlikdagi yo‘lovchi poezdlari harakati tashkil etiladigan temir yo‘l magistrallarining tasnifi

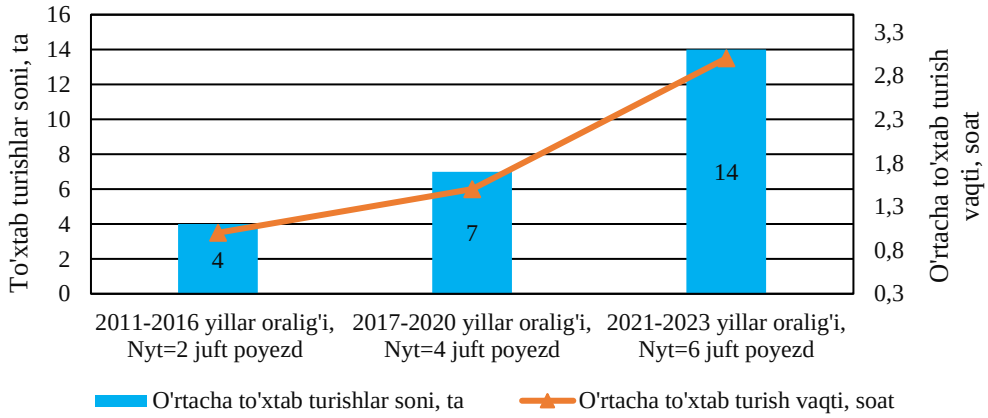
Respublika temir yo‘llarida maxsuslashtirilmagan temir yo‘l magistrallarida yuqori tezlikdagi yo‘lovchi, tezyurar va yuk poezdlari aralash tartibda harakati tashkil etilgan. Yuqori tezlikdagi yo‘lovchi poezdlari harakatining dastlabki yillarida bu tizimdan foydalanish maqsadga muvofiq, shuningdek kelgusida yuqori tezlikdagi yo‘lovchi poezdlar sonining ortib borishi natijasida temir yo‘l uchastkalarining foydalanish ko‘rsatkichlariga salbiy ta’sirlar yuzaga keladi. Buni inobatga olib, turli toifadagi poezdlar harakatini tashkil etishda temir yo‘l uchastkalaridan foydalanish ko‘rsatkichlarining mavjud holati o‘rganildi.

Temir yo‘ldan foydalanish ko‘rsatkichlari yuqori tezlikdagi “Afrosiyob” elektr poezdlari qatnovi ko‘lamiga bevosita bog‘liq. “O‘TY” AJda yuqori tezlikdagi yo‘lovchi poezdlari tomonidan amalga oshirilgan reyslar sonining yillar kesimidagi tahlili (5-rasm) shuni ko‘rsatdiki, bu ko‘rsatkich 2023 yilning dastlabki 9 oyi davrida 2021 yilga nisbatan qariyb 55,8 % o‘sgan.



5-rasm. “O‘TY” AJda yuqori tezlikdagi “Afrosiyob” elektr poezdlari reyslari sonining o‘zgarish dinamikasi

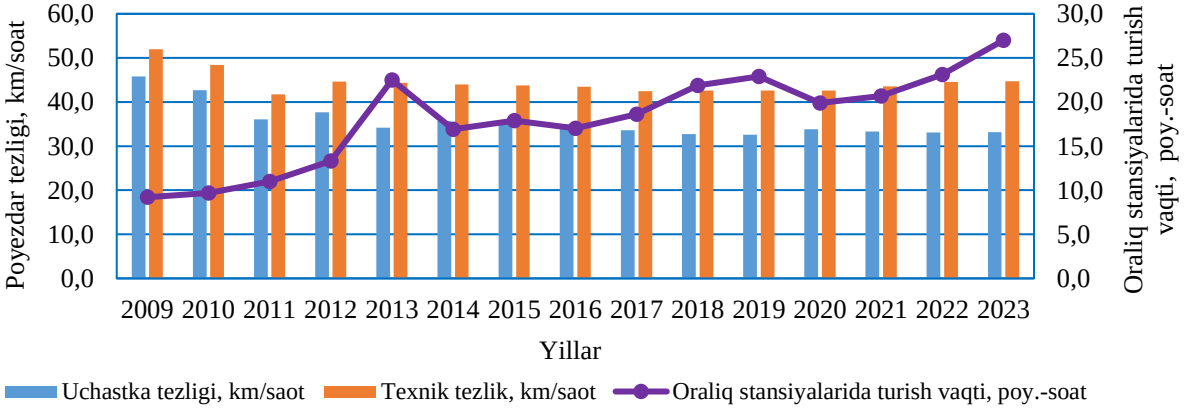
Yuqori tezlikdagi “Afrosiyob” elektr poezdlari reyslari sonining ortishi, shuningdek poezdlar harakatini “Toshkent – Samarqand – Qarshi–Shahrisabz, Toshkent – Samarqand – Buxoro uchastkalari umumiy foydalanishdagi temir yo‘llarda yuqori tezlikdagi elektr poezdlariga xizmat ko‘rsatish va qatnovini tashkil etish tartibi to‘g‘risida”gi Yo‘riqnoma [4] talablari asosida tashkil qilinishi temir yo‘ldan foydalanish ko‘rsatkichlariga salbiy ta’sir etmoqda. Jumladan Yo‘riqnomaning 29, 44- bandlariga asosan “Afrosiyob” elektr poezdlarini kirib kelishidan 30 daqiqa oldin stansiyadagi barcha manevr ishlari va olinadigan birliklarning yo‘l bo‘ylab boshqa harakatlari to‘xtatilishi, shuningdek ikki yo‘lli peregonlarda drezina, ishchi, xo‘jalik va yuk poezdlarining “Afrosiyob” elektr poezdlari bilan kesishuvi ta’qiqlanishi belgilab qo‘yilgan. 2011-2023 yillar oralig‘ida bajarilgan poezdlar harakati grafiklarining tahlili shuni ko‘rsatdiki, yuqori tezlikdagi “Afrosiyob” elektr poezdlarini o‘tkazish boshqa toifadagi poezdlarning ko‘plab miqdorda bekor turib qolishlarini yuzaga keltirdi. Jumladan, 2011-2016 yillar oralig‘ida yuk poezdlarini yuqori tezlikdagi yo‘lovchi poezdlarini o‘tkazib yuborish maqsadida bir kunlik jami to‘xtab turishlari soni o‘rtacha tani va har bir to‘xtash mobaynida turish vaqti soatni tashkil etdi. 2017-2020 yillar oralig‘ida esa to‘xtab turishlar soni tani, har bir to‘xtash mobaynida turish vaqti esa soatni tashkil etgan. 2021 yildan hozirgi kunga qadar to‘xtab turishlar soni tani, har bir to‘xtash mobaynida turish vaqti o‘rtacha soatni tashkil etdi (6-rasm).



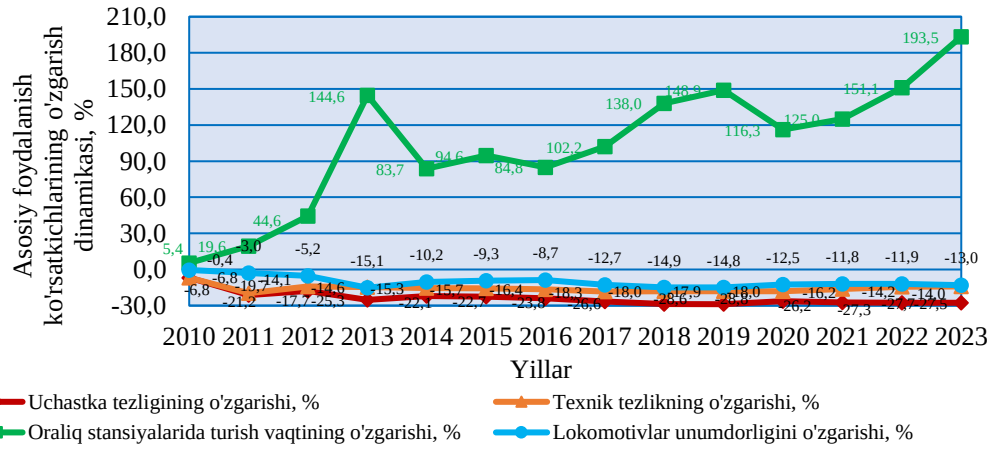
6-rasm. Yuqori tezlikdagi “Afrosiyob” elektr poezdlarini o‘tkazish mobaynida yuk poezdlarining kunlik o‘rtacha to‘xtab turishlari soni va davomiyligi

3. Natija va muhokama

Tahlillar ko‘rsatdiki, o‘rganilgan davrda yuqori tezlikdagi “Afrosiyob” elektr poezdlari sonining 1 juftdan 6 juftgacha o‘zgarishi natijasida kun davomida yuk poezdlarining to‘xtab turishlari sonini 3,5 marta, har bir to‘xtab turish vaqtining 3 marotabagacha ortishi yuzaga keldi. Bu borada “O‘TY” AJning tig‘iz sharoitlarda faoliyat yuritayotgan ikki yo‘lli “O‘zbekiston-Xovos” uchastkasining foydalanish ko‘rsatkichlari tahlil qilindi (7-8-rasmlar). Ushbu uchastkada qatnovchi yuqori tezlikdagi “Afrosiyob” elektr poezdlari sonining ortishi hamda ularni o‘tkazish mobaynida Yo‘riqnoma [4] ga muvofiq boshqa toifadaga poezdlarning harakati ta’qiqlanishi natijasida yuk poezdlarining oraliq stansiyalarida bekor turish vaqti 2023 yilning yanvar-sentyabr oylarida 2009 yilga nisbatan 193,5 % ga ortgan. Buning natijasida yuk poezdlarining uchastka tezligi 27,5 % ga, texnik tezligi 14% ga va lokomotivlar unumdorligi 13 % ga kamaygan.



7-rasm. “O‘zbekiston-Xovos” temir yo‘l uchastkasining asosiy foydalanish ko‘rsatkichlari



8-rasm. “O‘zbekiston-Xovos” temir yo‘l uchastkasi asosiy foydalanish ko‘rsatkichlarining 2009 yilga nisbatan o‘zgarish dinamikasi

Yaqin istiqbolda yuqori tezlikdagi yo‘lovchi hamda shahar atrof poezdlari sonining ortishi ko‘zda tutilgan. Jumladan, “O‘TY” AJ va Italiyaning “Arsenale Group” kompaniyalari o‘rtasida imzolangan memarandumga ko‘ra, 2026 yildan boshlab Toshkent-Samarqand-Buxoro-Xiva yo‘nalishida “lyuks” sinfidagi tezyurar turistik poezdlar harakati yo‘lga qo‘yiladi, shuningdek 2023-2026 yillar davrida “O‘TY” AJ faoliyatini tubdan isloh qilish doirasida Janubiy Koreyaning “Hyundai Rotem” kompaniyasidan 6 ta yuqori tezlikda harakatlanuvchi va Chexiyaning “Skoda Transportation” kompaniyasidan 30 ta tezyurar elektr poezdlar harakatini yo‘lga qo‘yish rejalashtirilgan [5-14]. Buni e’tiborga olgan holda, shuningdek rekonstruktiv va qayta qurish tadbirlarining katta hajmda kapital mablag‘lar va ularni amalga oshirish uchun uzoq muddat talab etilishini hisobga olib, turli toifadagi poezdlarning aralash harakati mavjud yuqori tezlikdagi magistrallarda yo‘lovchi poezdlarning yuk poezdlari harakatiga salbiy ta’sirini minimallashtirish, temir yo‘l uchastkalarining mavjud o‘tkazuvchanlik qobiliyatidan oqilona foydalanish, ish ko‘rsatkichlarini yaxshilash, pirovard natijada yo‘lovchilar va yuklarni o‘z manzillariga vaqtida yetkazib berish, sifatli servis xizmatlarini ko‘rsatish imkonini beruvchi tashkiliy-texnik chora-tadbirlar hamda ilg‘or texnologiyalarni ishlab chiqish va tatbiq etish zarurati yuzaga keladi. Buning uchun yuqori tezlikdagi magistrallarda poezdlar harakatini tashkil etish bo‘yicha ilg‘or davlatlarning tajribasi hamda bu borada mahalliy va xorijiy olimlarning tadqiqotlari tahlilini amalga oshirish maqsadga muvofiq.

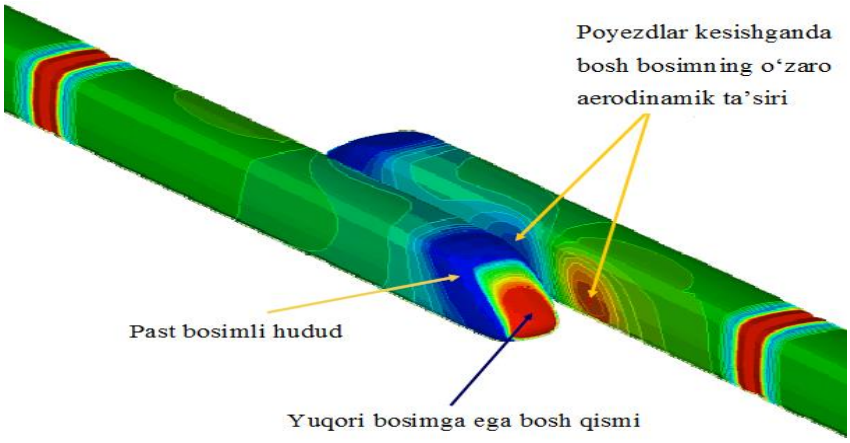
Yuqori tezlikdagi magistrallarda turli toifadagi poezdlar harakatini tashkil etish bo‘yicha xorijiy ish tajribasi, mahalliy va xorijiy ilmiy ishlar tahlili asosida SWOT - tahlili amalga oshirildi (1-jadval).

1-jadval

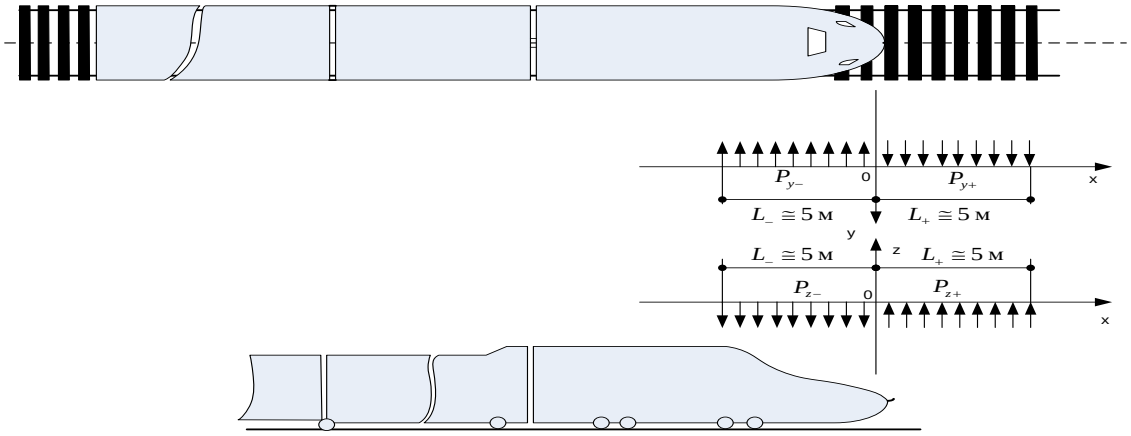
Yuqori tezlikdagi magistrallardan turli toifadagi poezdlarni o‘tkazish texnologiyasining SWOT-tahlili

KUCHLI TOMONLARI (STRENGHTS): S	KUCHSIZ TOMONLARI (WEAKNESSES): W
1) Texnik va texnologik imkoniyatlarning mavjudligi; 2) Ilmiy izlanishlar va chet el amaliy tajribasida ijobiy natijalarning mavjudligi; 3) Yuqori tezlikdagi yo‘lovchi poezdlari uchun alohida magistralni qurish mablag‘larini tejash; 4) Magistralning poezd o‘tkazish qobiliyatidan samarali foydalanish; 5) Temir yo‘ldan foydalanish ko‘rsatkichlarini yaxshilash.	1) Yuqori tezlikdagi yo‘lovchi poezdlari sonining ortishi bilan magistralning yuk poezdlarini o‘tkazish qobiliyatining pasayishi; 2) Yuk poezdlarining texnik va oraliq stansiyalarda ortiqcha turishlari tufayli tirbandliklarning yuzaga kelishi; 3) Yuk poezdlarining harakati tufayli yo‘lovchi poezdlar tezligiga cheklovlarning mavjudligi; 4) Yuqori tezlikdagi yo‘lovchi poezdi bilan peregonda kesishish ehtimoli bo‘lgan yuk poezdi tarkibini alohida tanlash zarurati; 5) Yuqori tezlikdagi yo‘lovchi poezdlari soniga muvofiq ravishda stansiyalarning texnologik jarayonlariga tezkor o‘zgartirishlar kiritilishi zarurati.
IMKONIYATLAR (OPPORTUNITIES): O	**TAHDIDLAR (THREATS): T**
1) Peregonlarda yuqori tezlikdagi yo‘lovchi va yuk poezdlarining to‘xtovsiz kesishuvini tashkil etish; 2) Temir yo‘l infratuzilmasini saqlashning integratsiyalashgan tizimini yaratish; 3) Stansiyalarning yo‘lovchi, yuk tizimi qurilma va inshootlarini kompleks rivojlantirish; 4) Mavjud temir yo‘llar orqali qisqa muddatlarda yuqori tezlikdagi yo‘lovchi poezdlar harakati qamrovini kengaytirish; 5) Yuqori tezlikdagi yo‘lovchi poezdlari harakatini xavfsiz tashkil etish bo‘yicha personalning amaliy tajribasini boyitish.	1) Yo‘lovchilarni tashish bo‘yicha transportning boshqa turlari bilan raqobatning kuchayishi; 2) Yuqori tezlikdagi yo‘lovchi poezdlari sonining ortishi bilan yuklarni yetkazib berish muddatining uzayishi; 3) Poezdlar harakatini tashkil etuvchilar hamda lokomotiv brigadalariga psixologik bosimning ortishi; 4) Temir yo‘l infratuzilmasi yuklamasining ortishi; 5) Temir yo‘l transporti texnik va texnologik taraqqiyotining ortda qolishi.

SWOT tahlilga ko‘ra yuqori tezlikdagi yo‘lovchi va yuk poezdlarini o‘tkazish texnologiyasining barcha kuchli va kuchsiz tomonlari o‘rganib chiqildi. “O‘TY” AJning amaldagi texnik-texnologik sharoitlarida yuqori tezlikdagi magistrallarda turli toifadagi poezdlarning o‘zaro xavfsiz kesishuvini amalga oshirish imkoniyatining mavjudligi aniqlandi. Bunga asosan, yuqori tezlikdagi magistrallarning turli toifadagi poezdlar aralash tartibda harakati tashkil etiladigan ikki yo‘lli uchastkalarida yuk poezdlarini to‘xtatmasdan o‘tkazish texnologiyasini qo‘llash maqsadida quyidagi masalalarni yechish zaruriyati yuzaga keladi. Xususan, turli toifadagi poezdlar harakatini ikki yo‘lli uchastkalarda tashkil etish usullarini hamda ular atrofida hosil bo‘ladigan turbulent havo oqimi tabiatini o‘rganish, yuqori tezlikdagi yo‘lovchi va yuk poezdlarini xavfsiz kesishuv shartlarini murakkab sharoitlar uchun aniqlash, poezdlarning o‘zaro kesishuv jarayonidagi kinematik parametrlarini hisoblash, shuningdek poezdlarning o‘zaro kesishuvi natijasida hosil bo‘ladigan maksimal aerodinamik bosim qiymatining bir qancha omillarga bog‘liqlik empirik ifodasini topish zarur. Ilmiy izlanishlar natijalariga ko‘ra qo‘shni yo‘llarda harakatlanuvchi tarkiblarning turg‘unligiga ko‘ndalang yo‘nalishdagi aerodinamik bosim va kuch miqdorlari salbiy ta’sir etadi va ularning cho‘qqisi poezdlar bosh qismida yuzaga keladi (9-10-rasmlar).



9-rasm. Qarama-qarshi harakatlanayotgan yuqori tezlikdagi poezdlar kesishganidagi aerodinamik bosim modeli



10-rasm. Yuqori tezlikdagi poezd bosh qismi atrofidagi bosim impulsi tabiati

Shu maqsadda poezdlar o‘zaro kesishuvi natijasida hosil bo‘ladigan va ularning turg‘unligiga salbiy ta’sir etuvchi maksimal aerodinamik bosim ifodasini bir qancha omillarga bog‘liqlik empirik ifodasini topish lozim, ya’ni

$$P = P\langle V,\ y,\ z, A,\ k,\ \rho,\ q\rangle\ , \qquad (1)$$

bunda: $V -$ poezdlarning harakatlanish tezligi, km/soat;

$y,\ z -$ qo‘shni yo‘l o‘qlari orasidagi masofa va oz yo‘nalishidagi balandlik, m;

$A -$ kuzatuvchi va o‘tkinchi poezd eni uzunligi, m;

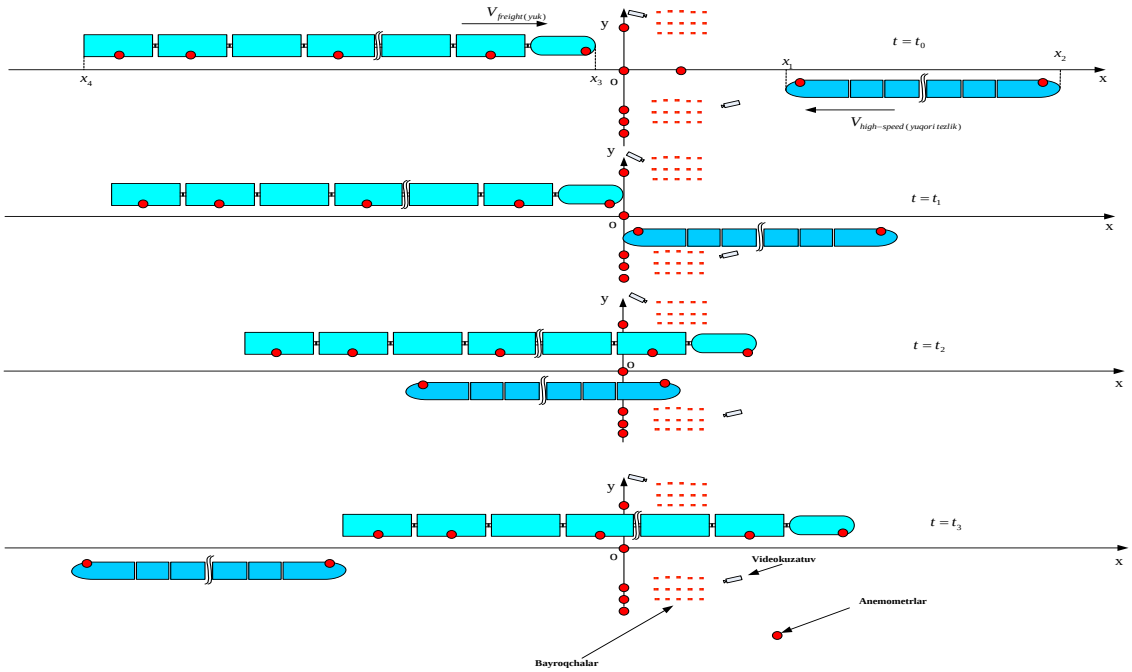
$k -$ poezdlarning geometrik tuzilishiga (bosh qismining tuzilishiga) bog‘liq bo‘lgan aerodinamik koeffitsient;

$\rho -$ havoning me’yoriy haroratdagi zichligi, kg/m3;

$q -$ boshqa o‘zgaruvchilar.

Poezdlar atrofida hosil bo‘ladigan aerodiamik bosim cho‘qqisining analitik hisoblash funksiyasini topishda jahonda mavjud ifodalar tahlili va “O‘TY” AJda mavjud poezdlar uchun eksperimental tadqiqotlarni amlaga oshirish talab etiladi. Eksperimental tadqiqotlar yordamida poezdlarning o‘zaro kesishuvi jarayonida hosil bo‘ladigan aerodinamik bosim miqdori hamda havo oqimi tezligini nafaqat oy yo‘nalishida, balki har bir yo‘nalish bo‘yicha aniqlash va ularning umumiy qiymatini hisoblash zarur. Shu maqsadda turli toifadagi poezdlarning to‘xtashsiz kesishuvi jarayonidagi eksperimental tadqiqotlar amalga oshirish uchun ularning o‘zaro kesishuv jarayonining davomiylik vaqti hisoblab olindi (11-rasm):

$$\begin{cases} t_{\min} \le t \le t_{\max} \\ t_{\min} = \dfrac{3{,}6\cdot(x_2 - x_1 + x_3 - x_4)}{v^{\max}_{high-speed(yuqoritezlik)} + v^{\max}_{freight(yuk)}} = \dfrac{3{,}6\cdot(l_1 + l_2)}{v^{\max}_{high-speed(yuqoritezlik)} + v^{\max}_{freight(yuk)}} \\ t_{\max} = \dfrac{3{,}6\cdot(x_2 - x_1 + x_3 - x_4)}{v^{\min}_{high-speed(yuqoritezlik)} + v^{\min}_{freight(yuk)}} = \dfrac{3{,}6\cdot(l_1 + l_2)}{v^{\min}_{high-speed(yuqoritezlik)} + v^{\min}_{freight(yuk)}} \end{cases} \qquad (2)$$



11-rasm. Turli toifadagi poezdlarning o‘zaro kesishuvi jarayonida aerodinamik ta’sirlarni o‘rganish bo‘yicha eksperimental tadqiqotlarni o‘tkazishda uskunalarni joylashtirish tartibi

bunda: t_{min} poezdlarni kesishuv jarayoni davomiyligining eng kichik miqdori, s;

t_{max} poezdlarni kesishuv jarayoni davomiyligining eng katta miqdori, s;

$x_1,\ x_2,\ x_3,\ x_4$ – poezdlarni ma’lum vaqt onidagi old va ort qismining koordinatalari, m;

$v^{max}_{high-speed(yuqoritezlik)}$, $v^{min}_{high-speed(yuqoritezlik)}$ yuqori tezlikdagi yo‘lovchi poezdining maksimal (230) va minimal (130) harakatlanish tezligi, km/soat;

$v^{max}_{freight(yuk)}$, $v^{min}_{freight(yuk)}$ yuk poezdining maksimal (70) va minimal (25) harakatlanish tezligi, km/soat;

$l_1,\ l_2$ – mos ravishda yuqori tezlikdagi yo‘lovchi (183) va yuk poezdlarining (815) uzunligi, m.

4. Xulosa

Yuqoridagi ifodaga asosan xulosa qilish mumkinki, turli toifadagi poezdlar o‘zaro kesishuv jarayonining davomiyligi poezdlar tezligiga bog‘liq ravishda 12 sekunddan 23,2 sekundgacha oraliqda bo‘lar ekan. Demak shu davr oralig‘ida aerodinamik bosim miqdorining va havo oqimi tezligi miqdorining o‘zgarish dinamikasini o‘rganish maqsadga muvofiq.

Qo‘shni yo‘llarda harakatlanuvchi tarkiblarning o‘zaro aerodinamik ta’sirining tabiati nafaqat ularning tezligiga, balki ularning turiga, harakatlanish yo‘nalishiga bog‘liq bo‘lishini va (1)-ifodani aniqlash natijalariga tayanib ularning xavfsiz kesishuv shart-sharoitlarini nazariy jihatdan aniqlanishi shuningdek, turli toifadagi poezdlarni o‘zaro kesishuv jarayonidagi turbulent havo oqimi tezligi natijasida harakat birliklari turg‘unligiga ta’sir etadigan bosim impulslarini modellashtrish maqsadga muvofiqdir. Keyingi tadqiqotlarda poezdlar o‘zaro kesishuv jarayonini modellashtirish uchun *ANSYS Fluent Flow (CFX)* va *SolidWorks Flow simulation* universal paket dasturlaridan foydalaniladi va eksperimetal tadqiqotlarni amalga oshirishda *3D Axis ultrasonic anemometer* uskunalaridan foydalanib poezdlar xavfsiz kesishuv tezliklari chegarasi belgilab beriladi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Bozorov Ramazon Shamil o‘g‘li	Toshkent davlat transport universiteti “Yuk transport tizimlari” kafedrasi katta o‘qituvchisi. t.f.f.d. (PhD). E-mail: ramazon-bozorov@mail.ru Tel.: +99891 2513377 https://orcid.org/0000-0001-8655-0764
Sattorov Samandar Baxtiyorovich	Toshkent davlat transport universiteti “Yuk transport tizimlari” kafedrasi dotsenti. t.f.n. E-mail: sattorovsamandar100@gmail.com Tel.: +99877 0735157 https://orcid.org/0000-0001-7273-0449
Saidivaliyev Shuxrat Umarxodjayevich	Toshkent davlat transport universiteti “Yuk transport tizimlari” kafedrasi dotsenti. t.f.f.d. (PhD). E-mail: shuxratxoja@mail.ru Tel.: +998974622129 https://orcid.org/0000-0002-4461-4093
Boboyev Diyor Shomurotovich	Toshkent davlat transport universiteti “Yuk transport tizimlari” kafedrasi assistenti. t.f.f.d (PhD). E-mail: diyor1803boboyev@gmail.com Tel.: +99890 4141803 https://orcid.org/0000-0003-0785-2209
Ergasheva Zaxro Valijanovna	Toshkent davlat transport universiteti “Yuk transport tizimlari” kafedrasi dotsenti. t.f.f.d. (PhD). E-mail: zahro2@yandex.ru Tel.: +998977162322 https://orcid.org/0000-0003-1651-0892

Experimental studies on the selection of spraying parameters of the spreader of technological materials and evaluation of their results

S.K.Turdibekov[1][a], E.X.Abdusamatov[1][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: This article presents the results of experimental studies conducted in order to determine the interaction between the parameters of the spreading disc and the material delivery mechanism. During the study, theoretical and experimental data were compared to study the interaction of the parameters of the spreading disk. As a result of experimental studies, the minimum, average and maximum values of the width of the sprinkler are 4.4; equal to 6.7 and 9.1 meters, and in theoretical calculations these values are 4.84; It was 7.24 and 9.66 meters. A comparison of the calculations showed that the theoretical values are on average 7% higher than the experimental data. These inconsistencies may be related to the non-compliance of the technological material, its moisture status, and the formation of dense lumps compressed during the experiment.

Keywords: road, disc radius, disc height, distance, rotational speed, spread and sprinkle, angular velocity, sowing width

Texnologik materiallarni tarqatuvchisining sepish parametrlarini tanlashbo'yicha eksperimental tadqiqotlar va ularning natijalarini baholash

Turdibekov S.K.[1][a], Abdusamatov E.X.[1][b]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Ushbu maqolada yoyish diskining parametrlari va materiallarni etkazib berish mexanizmining o'zaro ta'sirini aniqlash maqsadida olib borilgan eksperimental tadqiqotlar natijalari taqdim etiladi. Tadqiqot davomida yoyish diskining parametrlarining o'zaro ta'sirini o'rganish uchun nazariy va eksperimental ma'lumotlar taqqoslandi. Eksperimental tadqiqotlar natijasida, sepilishning kengligi minimal, o'rtacha va maksimal qiymatlari 4,4; 6,7 va 9,1 metrga teng bo'lib, nazariy hisob-kitoblarda ushbu qiymatlar 4,84; 7,24 va 9,66 metrni tashkil etdi. Hisob-kitoblarni taqqoslash shuni ko'rsatdiki, nazariy qiymatlar eksperimental ma'lumotlardan o'rtacha 7% ga yuqori. Ushbu nomuvofiqliklar texnologik materialning talablarga javob bermasligi, uning namlik holati va tajriba davomida siqilgan zich bo'laklarning shakllanishi bilan bog'liq bo'lishi mumkin.

Kalit so‘zlar: yo‘l, disk radiusi, disk balandligi, masofa, aylanma tezlik, yoyib sepish, burchak tezligi, sepish kengligi

1. Kirish

Shaharlar, ularning hududlari va aholisining o'sishi transport oqimlari ko'payishi va tarmoqlariining takomillashtirilishiga olib keladi. Shu sababli, zamonaviy yirik shaharning hayotiy faoliyati ko'p jihatdan turli mavsumiy davrlarda yo'l qoplamasining sifati va holatiga bog'liq bo'ladi.

Yo'llarni saqlash va tozalov-qarov ishlari bo'yicha asosiy va eng ko'p mehnat talab qiladigan ishlar qish mavsumida qor metamorfizmi, qor yoki muzda qisqa vaqt ichida o‘z xossalarini o‘zgartirish qobiliyati bilan bog'liq bo'lib, bu transport vositalari va piyodalarning harakati xavf tug‘diradi.

Turli mamlakatlarda yo'l xizmatlari qor va muzni yo'q qilish uchun texnologik materiallardan (qum-tuz aralashmasi) foydalanadi. Texnologik materiallardan foydalanish nisbatan qisqa vaqt ichida yo'l qoplamasidan muz va qorni bartaraf etish va tezlikni kamaytirish va baxtsiz hodisalardan hamda iqtisodiy jihatdan mumkin bo'lgan chegaralargacha yo'qotishlarni kamaytirish imkonini beradi.

Texnologik materiallarni sepish uchun maxsus mashinalar qo'llaniladi: texnologik material tarqatuvchilari avtomobil shassilari yoki tirkamalariga doimiy ravishda o'rnatiladigan yoki tez ajraladigan uskunalarga ega. Texnologik materiallarning samarali taqsimlanib sepilishini amalga osiruvchi organlarning parametrlari va ish rejimlarini to'g'ri tanlashga bog'liq bo'lib, bu juda dolzarb vazifadir.

2. Tadqiqot metodikasi

Texnologik materiallarni sepish parametrlarini tanlash bo'yicha eksperimental tadqiqotlar texnologik materiallar yoyib sepuvchisi asosiy transport vosita MAN CLA 18.280

[a] https://orcid.org/0009-0001-6098-5775
[b] https://orcid.org/0009-0007-1194-9085

4x2 BB CS45 bo'lgan yuk mashinasida amalga oshiriladi. Bu tanlangan texnologik materiallarni tarqatuvchisi O‘zbekiston Respublikasida mahalliylashtirish bo‘yicha eng yangi tanlov ekanligi bilan izohlanadi.

Ushbu mahalliylashtirilgan mahalliy texnologik materiallar tarqatuvchilarining asosiy texnik tavsiflari quyidagilardan iborat:

Uskunaning og'irligi	2600 kg gacha
Aylanish momentni uzatish	suyuqlik
Bunker sig’imi	6 m^3 gacha
Materialni etkazish turi:	qirg'ichli konveyer
sepish zichligi (nazariy)	350 g/m^2 gacha
Ishlov beriladigan tasma kengligi	9 m gacha
Uskunaning o'lchamlari, ±100 mm:	
- uzunligi	6520
- kengligi	1900
- balandligi	2670
Harakat tezligi km/soat,	
- ishchi/transport	20/40

Texnologik materiallar tarqatuvchining biriktirilgan uskunasida tajriba o'tkazishda asosiy o'lchash ishlari amalga oshiriladi, masalan:

- Yoyib sepish diskining parametrlari va joylashuvi;

-texnologik materiallarni etkazish mexanizmining parametrlari va sepish zichligini aniqlash.

Tajriba uchun ishlatiladigan o'lchov asboblari o'lchanadigan parametrlarni hisobga olgan holda tanlanadi va erishilgan natijalar quyidagilarga asoslanadi:

- Yoyib sepish diskining burchak tezligini topish uchun biz bu holda hal qilinadigan diapazonlarga ega bo'lgan taxometrdan foydalanamiz, - sepish diskining geometrik joyini va mexanizmining geometrik joylashishini topish uchun biz millimetrga bo'linish shkalali metrli o'lchagichdan foydalanamiz;

- sepish zichligini topish va materialning umumiy massasini aniqlash uchun biz shkali bo'lgan elektron tarozilardan foydalanamiz;

- o'tgan vaqt oralig'ini sekundlarda o'lchash uchun biz shkalasi bor sekundomerdan foydalanamiz.

Amaldagi o'lchov asboblari tegishli tekshiruvdan o'tgandan keyin qo'llaniladi.

Texnologik materiallarni tarqatuvchi eksperimental metodologiya ishchi organlarning ish rejimlari va ularning parametrlarining o'zaro ta'sirini aniqlashni o'z ichiga oladi.

Ushbu metodika tayyor osma qurilmalar uchun ishlab chiqilgan. Bunga asoslanib, yoyib sepish diskining balandligi $H_д$ va yoyib sepish diskining diametri $∅_д$ konstruksiya bo‘yicha o‘zgarishsiz qoladi va yoyib sepish diskining aylanish tezligi $\omega_д$ va material etkazib berish V_{TM} tezligi o‘zgaradi.

Tajriba o'tkazishda quyidagi shartlar zarur:

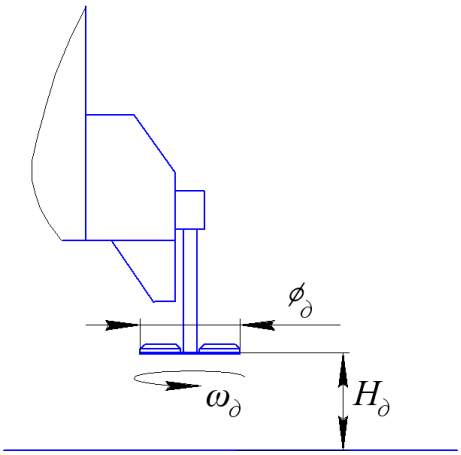
- texnologik materiallarning yaxshi ishlaydigan tarqatuvchisi;
- 2 m^3 miqdordagi bir hil massali texnologik material (don o'lchami 8 mm gacha bo'lgan qum-tuz aralashmasi);
- harakatlanishdan ajratilgan tekis, quruq, toza, maydon;
- quruq, shamolsiz muqobil ob-havo;
- eksperimentga xizmat ko'rsatuvchi xodimlarning xavfsizligi.

Tajribani o'tkazish uchun quyidagi talablarga rioya qilish kerak:

Yoyib sepish diskining parametrlarini aniqlashda o'lchovlar olinadi: diskning balandligi, diskning diametri va Yoyib sepish diskining aylanish tezligi.

Yoyib sepish diskining balandligini topish uchun o'lchovlar metr bilan, yo'l qoplamasi yuzasidan diskning yuqori tekisligigacha, yoyib sepsh diskning diametrini topish uchun o'lchovlar esa metr bilan amalga oshiriladi. Diskning bir chetidan pastki tekisligi bo’lab o'qning markazidan, diskning ikkinchi chekkasiga o'tadi.

Yoyib sepish diskining aylanish tezligini topish uchun o'lchovlar diskning pastki qismidagi taxometr bilan amalga oshirilishi kerak, uning markaziga qo'yish kerak. Yoyib sepsh diskning aylanish tezligini uchta ish rejimida o'lchadi: minimal, o'rtacha va maksimal. Barcha rejimlar boshqaruv tizimiga nisbatan qayd qilinishi kerak.

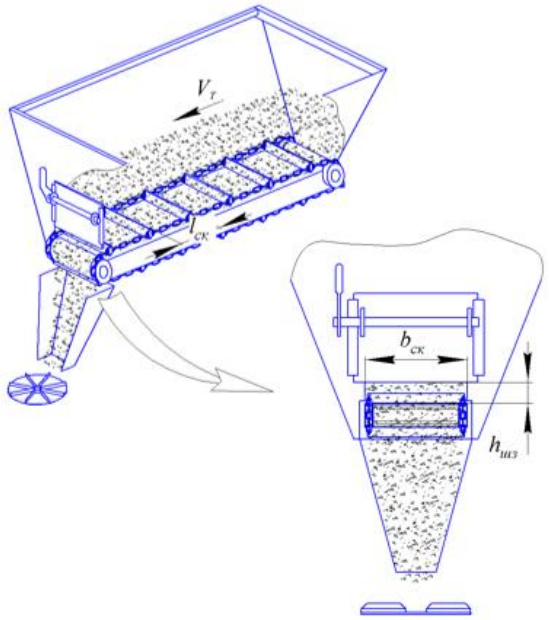


1-rasm. Yoyib sepish diskning parametrlari: $\omega_д$ - Yoyib sepish diskining burchak tezligi; $∅_д$ - Yoyib sepish diskining diametri; $H_д$ - Yoyib sepish diskining balandligi.

Yetkazish mexanizmining parametrlarini aniqlashda o'lchovlar olinadi: qirg'ichning kengligi, qopqoqli eshikning ochilish miqdori va yetkazish mexanizmining tezligi.

Qirg’ichning kengligi va qopqoqli eshikning ochilish miqdorini topish uchun o'lchovlar joyining yon tomonlaridan o’ramli metr bilan o'lchanadi.

Yetkazish mexanizmining tezligini topish uchun o'lchovlar mexanizmning bir aylanishining to'liq o'tishini belgidan o'lchash orqali soniya hisoblash bilan amalga oshiriladi, so'ngra mexanizmning aylanasini o'tgan vaqtga bo'linadi *($S/t=V_{TM}$)*. Etkazish mexanizmining tezligini uchta ish rejimida o'lchang: minimal, o'rtacha va maksimal. Barcha rejimlar boshqaruv tizimiga nisbatan qayd qilinishi kerak.



2-rasm. Qirg'ich konveyerining konstruktiv parametrlari: V_{TM} – texnologik materialni etkazish mexanizmining tezligi; b_{qk}- qirg'ichning kengligi; $h_{q.e.och}$ – qopqoqli eshikning ochilish miqdori; $l_{q.o.m}$ - qirg'ichlar orasidagi masofa.

Sepish $S_{s.k}$ kengligini aniqlash uchun tajriba o'tkazishda Yoyib sepish diskining burchak tezligi $\omega_д$, Yoyib sepish diskining diametri $\omega_д$ va Yoyib sepish diskining balandligi $H_д$ parametrlarini solishtirish kerak.

Bunday holda, Yoyib sepish diskining $\emptyset_д$parametrlari va Yoyib sepish diskining balandligi $H_д$ o'zgarmaydi va o'zgarmas bo'ladi, chunki tajriba texnologik materiallarning tayyor tarqatuvchisida o'tkaziladi. Yoyib sepish diskning burchak tezligi $\omega_д$ parametrlarda o'zgaruvchan bo'ladi.

Tajriba Yoyib sepish diskini minimal tezligida amalga oshiriladi Diskni minimal tezlikda yoqgandan so'ng, o'rtacha tezlikda material etkazuvchini ketma-ket yoqing. Ushbu ish rejimini 30 dan 60 soniyagacha saqlang, so'ngra texnologik materiallarni tarqatuvchini to'liq o'chiring. Sepilgan kenglikning izini o'lchash orqali sepish kengligini topish uchun o'lchovlarni bajaring (3.2.5-rasm).

Disk inqiloblari bundan mustasno, ushbu tajribani asl shaklda doimiy talablar bilan yana ikki marta takrorlang. Disk tezligini ikkinchi holatda o'rtacha tezlikda, uchinchi holatda esa maksimal tezlikda o'rnating.

S_{sk} Sepilish kengligini topishda etkazib beriladigan texnologik material miqdorining ta'siri hisobga olinmaydi, bunga asoslanib, V_{TM} materialni etkazib berish mexanizmining tezligi o'zgarmaydi. Taqdim etilgan texnologik materialning miqdori, asosan, kiyinish ρ zichligini aniqlashga ta'sir qiladi.

Sepilish ρ zichligini aniqlash uchun tajriba o'tkazish uchun asosiy mashina $V_м$ tezligi parametrlarini, materiallarni etkzish tezligi V_{TM} va Yoyib sepish diskining burchak $\omega_д$ tezligini taqqoslash kerak.

Ushbu tajribada barcha olingan parametrlarini uchta qiymat bo'yicha taqqoslash kerak.

Sepish ρ zichligini asosiy mashina $V_м$ tezligiga bog'liqligini topganda, $V_м$=0 da bajaring. Shunday qilib, mashinasi $V_м$=0 tezligida, 60 soniya vaqt ichida yoyib sepish diskining burchak tezligi $\omega_д$ va materialining etkazilish V_{TM} tezligi har xil bo'lganida sepilish ρ zichligini taqqoslanadi.

Birinchi holda, eksperiment 60 soniya vaqt bilan sepish kengligi va materialni etkazib berish mexanizmini kichik qiymatlarda o'rnatish orqali amalga oshiriladi. Belgilangan vaqtni saqlagandan so'ng, to'liq to'xtating va maydonda materiallarni yig'ish va tortish orqali sepilish ρ zichligini aniqlashni boshlang.

Ikkinchi va uchinchi hollarda, eksperimentni bir xil ketma-ketlikda sepish kengligi va materialni etkazib berish mexanizmiga mos ravishda o'rtacha va maksimal qiymatlarda o'zgartirish bilan takrorlang.

Keyinchalik, sepish S_{sk} kengligi qiymatini har bir tezlik bilan, o'rtacha va minimal materiallarni etkazib berish V_{TM} tezligini o'zgartirib tajribani davom ettiring.

To'ldirish zichligi ρ ni topish mashinaning tezlik parametriga ham bog'liq bo'lganligi sababli, mashinaning tezlik $V_м$ qiymati 5 km/soat, 10 km/soat va 15 km/ soat bo'lgan uchta tezlik uchun hisoblanishi kerak. Buning uchun biz quyidagi formulani qo'llaymiz.

$$\rho = \frac{\sum m}{60 \cdot S_{sk}} \cdot V_м; \text{g/m}^2 \qquad (3.1)$$

bu yerda, ∑m - Maydonda jami yig'ilgan materiallarning umumiy massasi, gram, da (3.2.6-rasm);

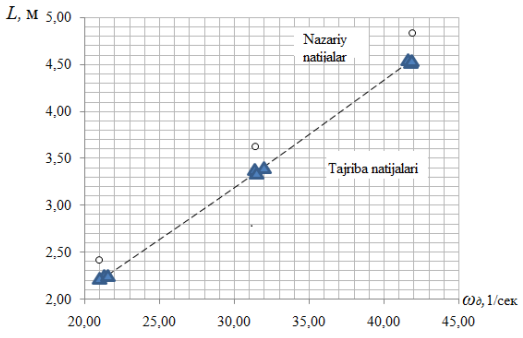
S_{sk} - sepiladigan texnologik materialning kengligi, m, da;

$V_м$ - asosiy mashinaning tezligi, m/sek.

Yoyib sepish diskining parametrlarini aniqlashda o'lchovlar o'tkazildi, Yoyib sepish diskining balandligi $H_д$, Yoyib sepish diskining diametri $\emptyset_д$ va Yoyib sepish diskining aylanishi $\omega_д$ B ilovadagi (1-jadval) jadvalga kiritilgan va ko'rsatilgan.

1-jadval

№	Parametr nomi	Miqdori	
1	Yoyib sepish diskining balandligi mm.	525	
2	Yoyib sepish diskining diametri mm.	600	
3	Diskning aylanish tezligi ayl/daqiqa (oborot/minut).	Minimal	200
		O'rtacha	300
		Maksimal	400



○-nazariy natijalar;△- eksperimental natijalar;
------- – tajribaning o'rtacha qiymati

3-rasm. Nazariy va eksperimental usulni o'tkazishda Yoyib sepish diski $\omega_д$ tezligining texnologik materialning sepish S_{sk} kengligiga bog'liqligi grafigi

Amalga oshirilgan o'lchovlar ko'rsatilgan texnologik materialning tarqalish S_{sk} kengligiga Yoyib sepish diskining $\omega_д$tezligining bog'liqligini aniqlashga imkon berdi. Barcha o'lchov natijalari jadvalga kiritilgan (2-jadval).

2-jadval

№	Aylanish parametrlari	Sepish kengligining qiymati m.	
		Nazariy natijalar	Tajriba natijalari
1	Minimal	4,84	4,4
2	O'rtacha	7,24	6,7
3	Maksimal	9,66	9,1

Olingan ma'lumotlardan ko'rinib turibdiki, hisoblangan nazariy ma'lumotlar sepish diskining uchta tezligi bo'yicha olingan eksperimental ma'lumotlardan o'rtacha 7% xatolik bo'ldi.

Yetkazish mexanizmining parametrlarini aniqlashda qirg'ichning kengligi b_{qk}, qopqoq eshikning ochilish balandligi $h_{q.e_{och}}$ va etkazish mexanizmi V_{TM} tezligi natijalari jadvalga kiritilgan (3-jadval).

3-jadval

№	Parametr nomi	Miqdori	
1	Qirg'ichning kengligi mm.	470	
2	Qopqoq eshikning ochilish balandligi mm.	60	
3	Qirg'ichlar orasidagi masofa mm.	920	
3	Materialni etkazish tezligi m/s	Minimal	0,0126
		O'rtacha	0,0226
		Maksimal	0,0339

Sepilish zichligini ρ aniqlash uchun tajriba o'tkazishda, materiallarni etkazish tezligi parametrlari V_{TM} va Yoyib sepish diskining burchak $\omega_д$tezligi mashina V_M =0 tezligi ko'rsatilgan..

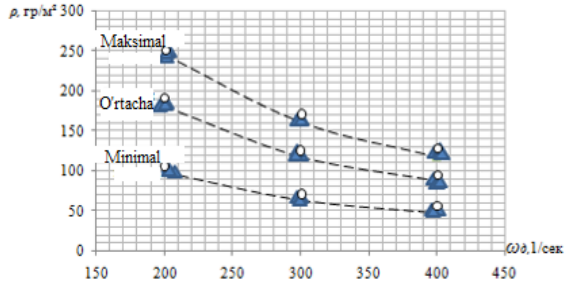
Sepilish zichligi ρ mashinaning tezlik parametriga ham bog'liq bo'lganligi sababli, eksperimentda biz formuladan foydalangan holda, 5 km/soat, 10 km / soat va 15 km / soat uch xil V_M tezlik bilan mashinaning tezlik qiymatini kiritdik.

Materialning sepilish zichligini aniqlash uchun barcha natijalar jadvalga kiritilgan (4-jadval).

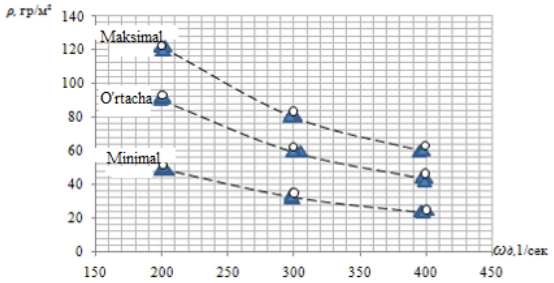
4-jadval

№	Mashinaning tezligi m/sek	Materialni yetkazish tezligi	Yoyib sepish diskining burchak tezligi	Sepilgan maydonidagi materialning miqdori g/m².
1	1,388 (5km/soat)	minimal	minimal	98
			o'rtacha	64
			maksimal	47
		o'rtacha	minimal	181
			o'rtacha	118
			maksimal	87
		maksimal	minimal	246
			o'rtacha	161
			maksimal	118
2	2,777 (10km/soat)	minimal	minimal	49
			o'rtacha	32
			maksimal	23
		o'rtacha	minimal	90
			o'rtacha	59
			maksimal	43
		maksimal	minimal	122
			o'rtacha	80
			maksimal	59
3	4,166 (15km/soat)	minimal	minimal	32
			o'rtacha	21
			maksimal	15
		o'rtacha	minimal	60
			o'rtacha	39
			maksimal	28
		maksimal	minimal	81
			o'rtacha	53
			maksimal	39

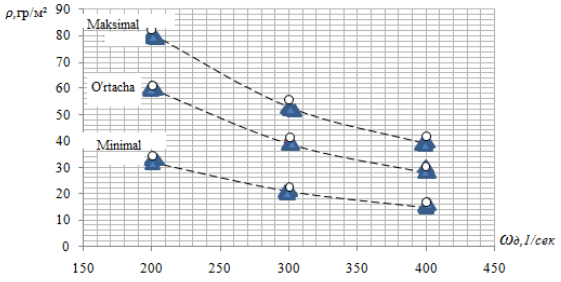
Olingan natijalarga asoslanib, sepilich zichligi ρ bo'yicha asosiy mashina V_M tezligini, etkzish mexanizmi V_{TM} tezligini va Yoyib sepish diskining burchak tezligini $\omega_д$ ni taqqoslaydigan bog'liqlik grafiklari tuzildi (4-rasm).



a) V_M 5 km/soat tezlikda;



b) V_M 10 km/soat tezlikda;



***s)* V_M 15 km/soat tezlikda**

○ –nazariy natijalar;△ - eksperimental natijalar; ------- – tajribaning o‘rtacha qiymati
4-rasm. Mashina V_M tezligining oshishini, V_{TM} etkazish mexanizmining tezligini va Yoyib sepish diskining burchak tezligini ω_∂ sepilishning ρ zichligiga taqqoslovchi bog'liqlik grafiklari.

Olingan ma'lumotlarga ko'ra, hisoblangan nazariy ma'lumotlar etkazish mexanizmining uchta tezligi uchun olingan eksperimental ma'lumotlardan o'rtacha 3% xatolik bilan oshib ketishini ko'rish mumkin.

Yetkazish mexanizmi bo'yicha olingan ma'lumotlardan shuni aytishimiz mumkinki, $h_{q.e_{och}}$qopqoq eshikning ochilish balandligining oshishi m² birlik uchun texnologik materialning miqdoriga ta'sir qiladi va shu bilan tezlik proportsionallik koeffitsientini (a) o'zgartiradi. Bunga asoslanib, $h_{q.e_{och}}$ qopqoq eshikning ochilishini oshirib ρ kerakli sepilish zichligiga moslashtirilishi mumkin.

3. Xulosa

Ishlab chiqilgan eksperimental tadqiqot uslubiyotidan foydalanib, yoyish diskining parametrlari va materiallarni etkazib berish mexanizmining o'zaro ta'sirini aniqlash uchun tajriba o'tkazildi.

Yoyib sepish disk parametrlarining o'zaro ta'siri bo'yicha tajriba davomida nazariy va eksperimental ma'lumotlarning qiymatlari aniqlandi va taqqoslandi.

Shunday qilib, eksperimental tadqiqotdan olingan ma'lumotlarga ko'ra, sepilishning kengligi minimal, o'rtacha va maksimal qiymatlarga: 4,4; 6,7 va 9,1 metr va nazariy hisob-kitoblarning qiymatlari: 4,84; 7,24 va 9,66 metrga teng. Hisob-kitoblarni taqqoslash shuni ko'rsatdiki, nazariy hisob eksperimentaldan o'rtacha 7% ga oshadi. Ko'rsatkichlardagi mavjud nomuvofiqliklar texnologik materialning talablarga javob bermasligi, uning namlik holati va tajriba davomida siqilgan zich bo'laklarning shakllanishi bilan bog'liq bo'lishi mumkin.

Materiallar bilan ta'minlash mexanizmi parametrlarining o'zaro ta'siri bo'yicha tajriba davomida nazariy va eksperimental ma'lumotlarning qiymatlari aniqlandi va taqqoslandi. Shunday qilib, eksperimental tadqiqotdan olingan ma'lumotlarga ko'ra,

material etkazish mexanizmining tezligi belgilangan proportsionallik koeffitsientini (a) belgilovchi konstruktiv parametrlarini material etkazish mexanizmining tezligi va mashinaning tezligi bilan hisoblangan qiymat nazariy qiymatdan o'rtacha 3% ga oshib ketishini ko'rsatdi.

Ko'rsatmalardagi bu nomuvofiqlik bunkerning ko’p yuklanishiga yo'l qo'yilganligi sababli yuzaga kelishi mumkin, ushbu konstruktiv parametrlarining noto'g'ri olinib tashlanishi, shuningdek, etkazish mexanizmining to'xtashi va kechikishiga ta'sir qiluvchi texnologik materialning to'plangan massasi bilan bog'liq bo'lishi mumkin.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Turdibekov Saloxiddin	Toshkent davlat transport universiteti “Yo‘l harakatini tashkil etish” kafedrasi katta o‘qituvchi E-mail: saloxiddinturdibekov987@gmail.com Tel.: +998977017410 https://orcid.org/0009-0001-6098-5775
Abdusamatov Erkinjon	Toshkent davlat transport universiteti “Yo‘l harakatini tashkil etish” kafedrasi assistenti E-mail: shamsher@inbox.ru Tel.: +998901131112 https://orcid.org/0009-0007-1194-9085

Analysis of energy management strategies for series hybrid electric vehicles

M.Sh. Keldiyarova[1][a], S.K. Ruzimov[1][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan
[2]Kimyo international university in Tashkent, Tashkent, Uzbekistan

Abstract: This paper focuses on the brief overview of available energy management strategies (EMS) for series hybrid electric vehicles. Alternatively, according to the mechanism that determines the control action, EMSs can be put into groups of rule-based and optimization-based methods. Each control method from each group has been extensively explained and compared in terms of advantages and disadvantages. The main goal of this section is to highlight important research gaps in the field as well as contribute to the increasing list of review debates.

Keywords: Rule-based method, thermostat, equivalent fuel consumption minimization strategy, series hybrid vehicle

1. Introduction

The number of electrified vehicles is increasing significantly due to reduce the consequences of exhaust gases from conventional vehicles in these days. Several architectures of electrified vehicles are available according to the number and location of energy sources. Pure electrical vehicles have only a large battery and it is a source for the propulsion. These kinds of vehicles do not exhaust any harmful emissions but they have limited driving range for long trips. In order to extend driving range of pure electrical vehicles, internal combustion engine is used as a second energy source. The vehicles which have more than a power source are called hybrid electric vehicles (HEV). Based on the location of energy sources, there are three types of HEVs. Series HEV, parallel HEV and series-parallel HEVs are commonly used to design vehicles in industry. HEVs require a supervisory algorithm which controls drivetrain components. The most point of control problem in HEVs is an instantaneous management of the power flow from the battery and the second power source in order to reach minimum fuel consumption with low emissions and to decrease the system cost while achieving good driving performance. In the series hybrid powertrin structure, the internal combustion engine (ICE) is disconnected to the wheels which engine operates at the highest efficiency point and it can be enable to control powertrain easier than other structure of HEVs [1]. Two common control strategies are to be discussed and analyzed for series HEVs including thermostat and energy consumption minimization strategy (ECMS).

2. Materials and methods

Several methods are developed to manage required power between two energy sources. The rule based and global optimized energy management strategies are commonly used to design vehicles. Thermostat control strategy is a type of rule based and it is not optimized yet. Whereas, ECMS is a type of optimized control method.

In order to analyze thermostat and ECMS for series hybrid system, data of the BMW i3 REX vehicle was used to validate the results. The main specifications of the vehicle is shown Table 1 [2].

Table 1

Mass	1315	kg
Engine power	25	kW
Electric motor power	125	kW
Battery capacity	60	Ah
Battery power	18.2	kWh

3. Series hybrid electric vehicle system

In series hybrid electric vehicle architecture, an electric motor delivers all required power to the wheels from electric battery and the generator which is connected to the ICE. The supervisory controller determines at each time how to split requested power (P_r) between generator powered by ICE and battery. Figure 1 describes how to split requested power among components of series HEV.

$$P_r = P_{gen} + P_b \quad (1)$$

According to the state of charge (SOC) of battery and required mechanical power, the generator helps to power the electric motors or helps to charge the battery. Due to the mechanical decoupling of the ICE from the wheels, it is realizable to operate ICE with higher efficiency [3].

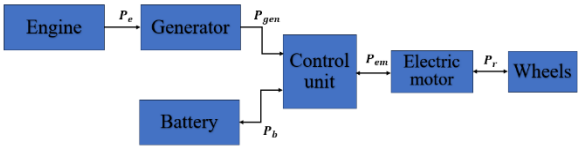


Figure 1. Series HEV structure

[a] https://orcid.org/0009-0001-5364-9335
[b] https://orcid.org/0009-0001-6098-5775

4. Thermostat control strategy

The energy management of series hybrid structure is more sample than parallel and series-parallel structures of HEVs. The thermostat control strategy is based on some logical rules and it is most common method to control engine. In this method, the engine is controlled by SOC of battery. When the SOC of battery reaches to its lower point, the engine will turn on and operates with constant value at high efficiency point. Whereas, when the SOC reaches to its higher point, the engine will turn off and drivetrain is completely propelled by battery. Therefore, the engine operates ON or OFF mode then, equation (1) is rewriten as a following equation [4].

$$P_g = \begin{cases} 0, & SOC > SOC_h, \quad OFF \\ P_r - P_b, & SOC_L < SOC < SOC_H, \quad ON \end{cases}$$

Where, P_g is engine connected generator power and P_b is battery power.

5. Energy consumption minimization strategies

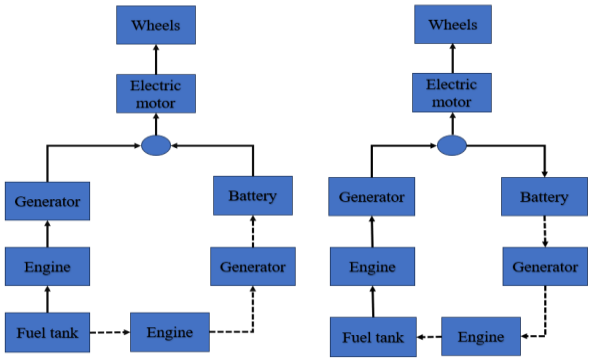
Thermostat control strategy is sample and robust, therefore it does not required supervisory controller for series HEV system. On the other hand, it is not optimized to reach minimum fuel consumption and other performances. In these years, scientists focus on optimizing the power split by minimizing instantaneous fuel consumption for HEVs.

The main concept of ECMS is to minimize fuel consumption at each time instant by converting electricity consumption into the equivalent fuel consumption. The dimensionless conversion ratio is called equivalence factor and it is control variable of ECMS. The equivalent fuel consumption rate is given as equation (4).

$$\dot{m}_{fc} = \dot{m}_f + \dot{m}_e = \dot{m}_f + \frac{s}{Q_{LHV}} P_e \qquad (4)$$

Where, $\dot{m}_f$ – intantaneous fuel consumption of the engine, s – equivalence factor, Q_{LHV} – lower heating value of fuel and P_e – electric motor power.

At any moment, the electric energy discharged from the battery needs to be recharged back to the battery in the future. This is equivalent to positive fuel consumption of the engine. On the other hand, the energy charged to the battery at any moment will also be discharged from the battery to drive the vehicle in the future. This is equivalent to negative fuel consumption for the engine [5]. The basic principle of ECMS for series HEV is shown on Figure 2.



a) negative fuel consumption b) positive fuel consumption

Figure 2. The basic principle of ECMS for series HEV

6. Results and discussion

Based on the architecture and design parameters, a series HEV model was built in MATLAB/Simulink software [6]. Thermostat control strategy was simulated and evaluated using this model.

The results were compared with experimental data which was collected on Argonne National laboratory [7]. It is shown that, working line of the ICE is the same with experimental data. However, there were some disrepancies on fuel consumption because the thermostat control strategy is not optimized. Figure 3 shows the comparison of ICE speed and fuel consumption with experimental data.

7. Conclusion and future work

Thermostat and energy consumption control strategies for series HEV have been analyzed in this paper. Validation of the thermostat control strategy has been done on the designed model of seies HEV using data of BMW i3 REX. The engine speed and fuel consumption have been compared and with experimental data In the future studies, optimized method which is ECMS will be designed for this model to improve fuel consumption and other performances.

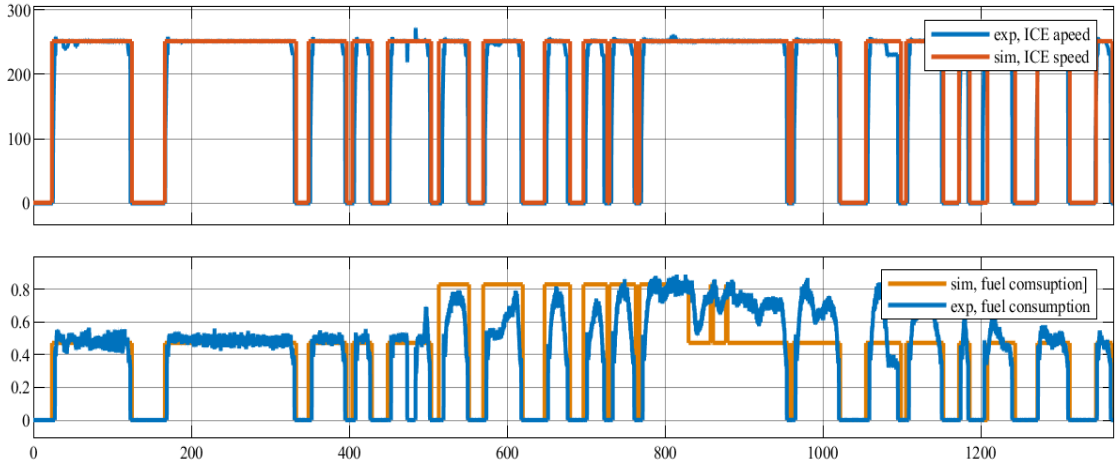


Figure 3. Comparison of ICE speed and fuel consumption of series HEV

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Information about the authors

Keldiyarova Malika Shuhrat qizi	Toshkent davlat transport universiteti “Transport vositalari muhandisligi” kafedrasi tayanch doktoranti, E-mail: malika.keldiyarova1995@gmail.com Tel: +998976779516 https://orcid.org/0009-0003-8797-8609
Ruzimov Sanjarbek Komilovich	Toshkent Kimyo xalqaro universiteti “Yo‘l harakati muhandisligi va boshqaruvi” kafedrasi professor vazifasini bajaruvchisi, E-mail: sanjar.ruzimov@gmail.com Tel.:+998998704117 https://orcid.org/0009-0001-6098-5775

Determining the effectiveness of seismic barriers by varying their distance from buildings

Sh.S. Yuldashev[1][a], A.Sh. Abdunazarov [1][b]
[1]Namangan Engineering-Construction Institute, Namangan, Uzbekistan

Abstract: In the article, the impact of seismic surface waves on the building was determined using the finite element method (FEM) with the help of the Plaxis 3D software package. The amplitude of stress, displacement, velocity, and acceleration at each point was identified, and seismic barriers were employed to mitigate these effects. The effectiveness was assessed by varying the distance between the building and the seismic barrier. Seismic barriers, with a thickness of 1 meter and a height of 3 meters, were placed at distances of 24, 26, 28, and 30 meters from the center of the building. The results were compared with those in the absence of barriers, and the effectiveness was analyzed.

Keywords: the building, seismic surface waves, seismic barrier, finite element method, elasticity theory, and soil model

Binolarni seysmik to‘lqinlardan himoya qilishda seysmik to‘siqning masofaviy joylashuvi samaradorligini aniqlash

Yuldashev Sh.S.[1][a], Abdunazarov A.Sh.[1][b]
[1]Namangan muhandislik-qurilish instituti, Namangan, O‘zbekiston

Annotatsiya: Maqolada binoga seysmik sirt to‘lqinlarining ta’siri Plaxis 3D dasturiy majmuasi yordamida chekli elementlar usulini qo‘llagan holda aniqlangan. Har bir nuqtadagi kuchlanish, ko‘chish, tezlik va tezlanishning amplitudalari aniqlangan va kamaytirish maqsadida seysmik to‘siq qo‘llanilgan hamda seysmik to‘siq bilan bino oraliq masofasini o‘zgartirish orqali samaradorligi aniqlangan. Seysmik to‘siqlar bino markazidan radiusi 24, 26, 28 va 30 metr uzoqlikda qalinligi 1 metr va balandligi 3 metrli qilib joylashtirilgan va to‘siqsiz hol natijalari bilan taqqoslangan va samaradorligi tahlil qilingan.

Kalit so‘zlar: Bino, seysmik sirt to‘lqinlari, seysmik to‘siq, chekli elementlar usuli, elastiklik nazariyasi va grunt modeli

1. Kirish

So‘nggi yillarda dunyoda talafotli zilzilalar soni ortib, ular aholi hayoti va mamlakatlarning ijtimoiy-iqtisodiy infratuzilmalariga jiddiy ta’sir ko‘rsatayotganligi sababli seysmik xavfsizlikni ta’minlash va qurilayotgan bino-inshootlarning seysmik mustahkamligini ta’minlash hamda zilzilabardoshligini yanada oshirish bo‘yicha bir qator ilmiy tadqiqotlar olib borilmoqda. Jumladan binolarga vibratsiya va seysmik sirt to‘lqinlarining ta’sirini aniqlash hamda seysmik to‘siqlar yordamida so‘ndirish katta ilmiy-amaliy ahamiyat kasb etmoqda.

2. Tadqiqot metodikasi

Palas Mandal va Surendra Nadh Somala [1] seysmik to‘siqlar bilan oraliq masofani o‘zgartirish orqali ularning samaradorligini aniqlash bo‘yicha ko‘plab tadqiqotlar o‘tkazgan. Seysmik to‘siqlarni tuproqning turli xususiyatlariga mos ravishda o‘rnatish bo‘yicha tavsiyalar bergan. Gruntning zichligi va namligining seysmik to‘siqlarga ta’sirini o‘rgangan.

Anastasios Sextos [2] seysmik to‘siqlarni dizayn qilish va ularni binolar atrofida optimal joylashtirish bo‘yicha ko‘rsatmalar ishlab chiqqan. Tadqiqotlar shuni ko‘rsatdiki, yumshoq va nam tuproqli hududlarda seysmik to‘siqlarni binodan uzoqroqda joylashtirish, uning samaradorligini oshiradi.

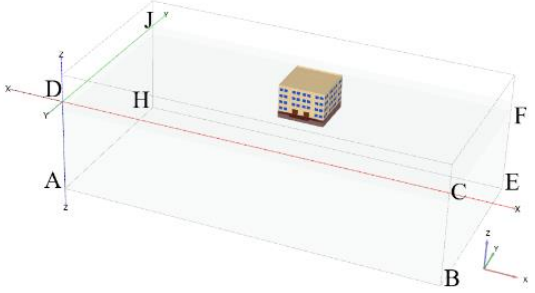
Nakashima [3] tadqiqotlari seysmik to‘siqlarni qanday qilib samarali joylashtirish orqali binolarni himoya qilish mumkinligini o‘rganishga qaratilgan bo‘lib, u yuqori seysmik faollik bo‘lgan hududlarda seysmik to‘siqlarni qayerda joylashtirish kerakligini aniqlagan. U bo‘sh gruntlarda seysmik to‘siqlarni binolardan 20-30 metr masofada joylashtirish kerakligi to‘g‘risida xulosaga kelgan.

Ko‘rib chiqilayotgan masalada Reyle sirt to‘lqinining binoga ta’sirini kamaytirish choralari aniqlanadi va qiyosiy tahlil qilinadi. Sirt to‘lqinlarining elastik gruntda joylashgan ko‘p qavatli binoga ta’siri masalasi ko‘rib chiqiladi. Masala elastiklik nazariyasining uch o‘lchamli masalasiga keltiriladi va uni yechish uchun chekli elementlar usuli qo‘llaniladi. Ma’lumki sonli usullar chekli sohaga qo‘llaniladi.

Masalada cheksiz yarim fazoni chekli soha bilan almashtiramiz. Bunda chegaralarda to‘lqinlarning cheksizlikka intilishini ta’minlovchi quyidagi shartlar

[a] https://orcid.org/0000-0002-3992-9066
[b] https://orcid.org/0009-0003-1614-0913

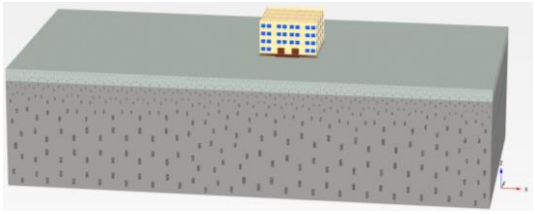
qo‘yilgan. Ajratilgan parallelepipedning AHJD va BEFC yog‘larida (a), ABCD va HEFJ yog‘larida (b) hamda ABEH yog‘ida (c) shartlar qo‘yilgan (1-rasm).



1-rasm. Chegaraviy shartlar qo‘yilishi

$$\left.\begin{aligned}\sigma_x &= a\rho V_p\dot{u}\\ \tau_{yz} &= b\rho V_s\dot{u}\\ \tau_{zy} &= b\rho V_s\dot{w}\end{aligned}\right\}\text{a)}\quad \left.\begin{aligned}\sigma_y &= a\rho V_p\dot{v}\\ \tau_{xz} &= b\rho V_s\dot{w}\\ \tau_{zx} &= b\rho V_s\dot{u}\end{aligned}\right\}\text{b)}\quad \left.\begin{aligned}\sigma_z &= a\rho V_p\dot{w}\\ \tau_{xy} &= b\rho V_s\dot{u}\\ \tau_{yx} &= b\rho V_s\dot{v}\end{aligned}\right\}\text{c)}\quad (1)$$

Tanlab olingan model uzunligi 200 *m* eni 100 *m* va chuqurligi 50 *m* o‘lchamlarga ega. Masalada yer osti suvlari borligi ham hisobga olinadi, yer osti suvlarining sathi 20 *m* chuqurlikda deb olingan. Bino 24 *m* uzunlikda, eni 24 *m* va balandligi 14.75 *m*, qavat balandligi 3,3 *m*, binoning yer to‘la qismi esa 3 *m* chuqurlikda joylashgan. birinchi qatlami 5 metr qumloq (suglinka), ikkinchi qatlami 45 metr shag‘alli (galichniy) grunt modellashtirildi (2-rasm).



2-rasm. Grunt modeli va turar joy binosini chekli elementlarga bo‘lish

Tadqiqot sohasi 46739 ta chekli elementga va 85663 ta tugunlarga ajratilgan. Cheki elementlarning shakllari noto‘g‘ri tetraedr shaklida tanlanadi (1-rasm).

Harakat differensial tenglamalar sistemasining tartibi $85633 \times 3 = 256\,899$ ga teng.

Bu yerda x o‘qi bo‘ylab Reyle to‘lqini harakatlanadi deb tasavvur qilamiz. Materialning fizik-mexanik xususiyatlarini hisobga olgan holda gruntdagi tugunlardagi ko‘chish, tezlik va tezlanishlarini aniqlaymiz.

Dinamik yuk ta’siridagi diskret mexanik sistema harakatining differensial tenglamalar sistemasi quyidagicha ifodalanadi:

$$\boldsymbol{M\ddot{u} + C\dot{u} + Ku = F} \qquad (2)$$

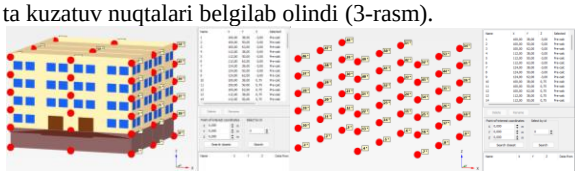
Bu yerda $\boldsymbol{M}$ – massalar matrisasi, $\boldsymbol{C}$ – so‘ndirish matrisasi, $\boldsymbol{K}$ – bikrlik matrisasi va $\boldsymbol{F}$ – dinamik yuk vektori. $\boldsymbol{u}$ – ko‘chish, $\boldsymbol{\dot{u}}$ – tezlik va $\boldsymbol{\ddot{u}}$ – tezlanishlar vektorlari vaqtning uzuluksiz funksiyalari deb olindi.

(2) tenglamalar sistemasini yechish uchun Nyumark usulidan foydalanamiz.

Dinamika masalasini raqamli ifodalashda vaqt iteratsiyasini shakllantirish hisoblash jarayonining barqarorligi va aniqligi uchun muhim omil hisoblanadi.

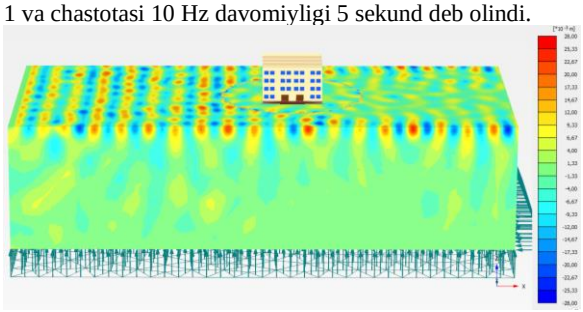
Nyumark usulining vaqt iteratsiyasi koeffitsentlarini $\alpha = 0.25$ va $\beta = 0.5$ deb qabul qilamiz. Grunt va bino materialining xususiyatlari 1 jadvalda keltirilgan.

Binoga ta’sir etayotgan seysmik sirt to‘lqinlarni aniqlash va taqqoslash uchun binoning har qavatidan 9 ta jami esa 54 ta kuzatuv nuqtalari belgilab olindi (3-rasm).



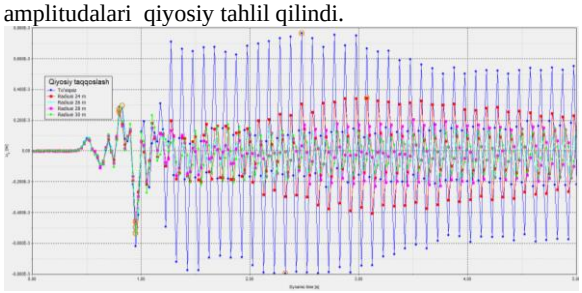
3-rasm. Kuzatuv nuqtalari

Seysmik sirt to‘lqinlarni tarqalishini Garmonik kuch orqali hosil qilindi. Garmonik kuchning fazasi 0, amplitudasi 1 va chastotasi 10 Hz davomiyligi 5 sekund deb olindi.



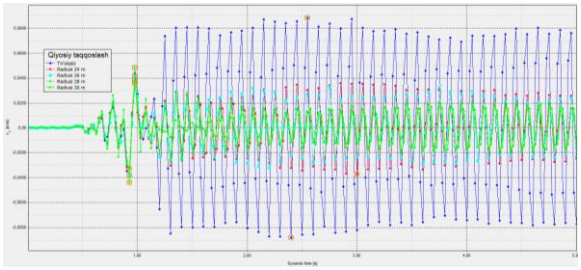
4-rasm. Seysmik sirt to‘lqinlarni binoga ta’sir etish jarayoni

Binoga ta’sir etayotgan seysmik sirt to‘lqinlarni kamaytirish va seysmik to‘siqlarni afzalligni aniqlash uchun bino markazidan radiusi 24, 26, 28 va 30 metr uzoqlikda seysmik to‘siqlar loyihalashtirilganda, binoning $\boldsymbol{z}$ o‘qi bo‘yicha ko‘chishning belgilangan nuqtalaridagi eng yuqori amplitudalari qiyosiy tahlil qilindi.



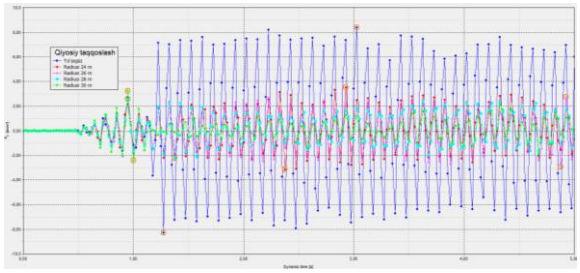
5-rasm. 23-kuzatuv nuqtasidagi ko‘chishni taqqoslash grafiki

5-rasmda, atrofida xech qanday to‘siq joylashmagan modeldagi binoning 23-kuzatuv nuqtasida seysmik sirt to‘lqinning $\boldsymbol{z}$ o‘qi bo‘yicha ko‘chishning maksimal qiymati u_{zmax} =0,797 *mm*, radiusi 24 metrli seysmik to‘siq joylashgan binoda u_{zmax} =0,496 *mm*, radiusi 26 metrli seysmik to‘siq joylashgan binoda u_{zmax} =0,534 *mm*, radiusi 28 metrli seysmik to‘siq joylashgan binoda u_{zmax} =0,458 *mm*, radiusi 30 metrli seysmik to‘siq joylashgan binoda 0,461 *mm* ni tashkil etdi. Qiyosiy taqqoslanganda, atrofida xech qanday to‘siq joylashmagan holga nisbatan radiusi 24 metrli seysmik to‘siq joylashganda binoning 23-kuzatuv nuqtasidagi ko‘chish 37.7%, radiusi 26 metrli seysmik to‘siq joylashgan binoda 32.97%, radiusi 28 metrli seysmik to‘siq joylashgan binoda 42.48%, radiusi 30 metrli seysmik to‘siq joylashgan binoda 42.14% ga teng bo‘lgan seysmik to‘siqlar samaradorligi qayd etildi.



6-rasm. 23-kuzatuv nuqtasidagi tezlikni taqqoslash grafiki

6-rasmda, atrofida xech qanday to‘siq joylashmagan modeldagi binoning 23-kuzatuv nuqtasida seysmik sirt to‘lqinning v_z o‘qi bo‘yicha tezlikning maksimal qiymati v_{zmax} =8,83 *sm/s*, radiusi 24 metrli seysmik to‘siq joylashgan binoda v_{zmax} =4,82 *sm/s*, radiusi 26 metrli seysmik to‘siq joylashgan binoda v_{zmax} =4,15 *sm/s*, radiusi 28 metrli seysmik to‘siq joylashgan binoda v_{zmax} =3,79 *sm/s*, radiusi 30 metrli seysmik to‘siq joylashgan binoda v_{zmax} =3,58 *sm/s* tashkil etdi. Qiyosiy taqqoslanganda, atrofida xech qanday to‘siq joylashmagan holga nisbatan radiusi 24 metrli seysmik to‘siq joylashganda binoning 23-kuzatuv nuqtasidagi tezlik 45,41%, radiusi 26 metrli seysmik to‘siq joylashgan binoda 53.00%, radiusi 28 metrli seysmik to‘siq joylashgan binoda 57.08%, radiusi 30 metrli seysmik to‘siq joylashgan binoda 59.45% ga teng bo‘lgan seysmik to‘siqlar samaradorligi qayd etildi.



7-rasm. 23-kuzatuv nuqtasidagi tezlanishni taqqoslash grafiki

7-rasmda, atrofida xech qanday to‘siq joylashmagan modeldagi binoning 23-kuzatuv nuqtasida seysmik sirt to‘lqinning a_z o‘qi bo‘yicha tezlanishning maksimal qiymati a_{zmax} =83,94 *sm/s*^{2}, radiusi 24 metrli seysmik to‘siq joylashgan binoda a_{zmax} =35,28 *sm/s*^{2}, radiusi 26 metrli seysmik to‘siq joylashgan binoda a_{zmax} =32,50 *sm/s*^{2}, radiusi 28 metrli seysmik to‘siq joylashgan binoda a_{zmax} =29,20 *sm/s*^{2}, radiusi 30 metrli seysmik to‘siq joylashgan binoda a_{zmax} =25,93 *sm/s*^{2} tashkil etdi. Qiyosiy taqqoslanganda, atrofida xech qanday to‘siq joylashmagan holga nisbatan radiusi 24 metrli seysmik to‘siq joylashganda binoning 23-kuzatuv nuqtasidagi tezlanish 57,97%, radiusi 26 metrli seysmik to‘siq joylashgan binoda 61,28%, radiusi 28 metrli seysmik to‘siq joylashgan binoda 65.21%, radiusi 30 metrli seysmik to‘siq joylashgan binoda 69,10% ga teng bo‘lgan seysmik to‘siqlar samaradorligi qayd etildi.

3. Xulosa

Binoga ta’sir etayotgan seysmik sirt to‘lqinlarni kamaytirish uchun va bino markazidan radiusi 24, 26, 28 va 30 metr bo‘lgan aylana shaklida seysmik to‘siq modellashtirib seysmik sirt to‘lqinlarni kamaytirish jarayoni ko‘rib chiqildi.

Olingan natijalarga asoslanib, 5-7 rasmdagi grafiklardan ko‘rinib turibdiki, atrofida xech qanday to‘siq joylashmagan holga nisbatan bir xil koordinatada joylashgan bino markazidan radiusi 24 metr uzoqlikda joylashgan seysmik to‘siqli binoda ko‘chish o‘rtacha 11.76%, tezlik 54.39% va tezlanish 46.34%, radiusi 26 metr uzoqlikda joylashgan seysmik to‘siqli binoda ko‘chish o‘rtacha 18.90%, tezlik 55.25% va tezlanish 48.39%, radiusi 28 metr uzoqlikda joylashgan seysmik to‘siqli binoda ko‘chish o‘rtacha 24.05%, tezlik 56.53% va tezlanish 50.13%, radiusi 30 metr uzoqlikda joylashgan seysmik to‘siqli binoda ko‘chish o‘rtacha 26.13%, tezlik 57.57% va tezlanish 50.78%, ga teng bo‘lgan seysmik to‘siqlar samaradorligi qayd etildi.

Olingan natijalar, seysmik to‘siqlarni joylashtirishning muhimligini tasdiqlaydi va binolarni zilzila xavfidan himoya qilishda samarali choralar ko‘rish zarurligini ko‘rsatadi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Yuldashev Sharafitdin Sayfitdinovich	Namangan muhandislik-qurilish instituti, “Materiallar qarshiligi va mexanika” kafedrasi professori, t.f.d. Sh.yuldashev1953@gmail.com Tel.: +998974275438 https://orcid.org/0000-0002-3992-9066
Abdunazarov Akbarjon Shamsuddin o‘g‘li	Namangan muhandislik-qurilish instituti, “Qurilish materiallari va buyumlari” kafedrasi o‘qituvchisi, Abdunazarovakbar16@gmail.com Tel.: +998911860505 https://orcid.org/0009-0003-1614-0913

Formation of problems of elastoplastic deformation of three-dimensional bodies

M.M. Rasulmuhamedov[1][a], Sh.B. Shukurova[1][b], Z.M. Mirzaeva[1][c]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: Formulation of three-dimensional elastoplastic problems, finite elements in the calculation of bodies with elastoplastic three-dimensional complex shape (with voids, inclusions and cavities), algorithms for using Vlasov-Kantorovich, finite difference methods, calculation of coefficients of the system of solving equations solution algorithms are presented. By employing a combination of theoretical analysis and numerical simulations, we explore the interplay between elastic and plastic behaviors under various loading conditions. The research highlights the significance of material properties, geometric configurations, and boundary conditions in influencing deformation patterns.

Keywords: three-dimensional bodies, elastoplastic process, finite elements, finite difference, Vlasov-Kantorovich methods

Uch o‘lchovli xajmli jismlarning elastoplastik deformatsiyasi masalalarini shakllantirish

Rasulmuhamedov M.M.[1][a], Shukurova Sh.B.[1][b], Mirzayeva Z.M.[1][c]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Uch o‘lchovli elastoplastik masalalarni shakllantirish, elastoplastik uch o‘lchovli murakkab shaklga (bo‘shliqlar, qo‘shimchalar va chuqurchalar bilan) ega jismlarni hisoblashda chekli elementlar, Vlasov-Kantorovich, chekli ayirmalar usullarini qo‘llash algoritmlari, tenglamalarni yechish tizimining koeffitsiyentlarini hisoblashning yechish algoritmlari keltiriladi. Nazariy tahlil va raqamli simulyatsiyalar kombinatsiyasidan foydalanib, biz turli xil yuklash sharoitida elastik va plastik xatti-harakatlar o'rtasidagi o'zaro bog'liqlikni o'rganamiz. Tadqiqot materialning xususiyatlari, geometrik konfiguratsiyasi va chegara sharoitlarining deformatsiya shakllariga ta'sir qilishdagi ahamiyatini ta'kidlaydi.

Kalit so‘zlar: uch o‘lchovli jismlar, elastikoplastik jarayon, chekli elementlar, chekli ayirma, Vlasov-Kantorovich usullar

1. Kirish

Ortogonal $OX_1X_2X_3$ egri chiziqli koordinatalar tizimida V hajmli ixtiyoriy shakldagi qattiq jismni ko‘rib chiqamiz, unga S_p sirt qismlariga statik va dinamik yuklar $P(P_x,P_y,P_z)$ ta’sir qiladi va S_u qismida $U_{(u,v,w)}$ ko‘chishlarni berilishini hisobga olamiz. Bundan tashqari - $R(R_x,R_y,R_z)$, xajmli kuchlarni berilishi mumkin.

Jismning kuchlanish-deformatsiya holati {KDH} kuchlanish $\{\sigma_{ij}\}$ va deformatsiyasi $\{\varepsilon_{ij}\}$ tenzori bilan tavsiflanadi , ular fazoviy koordinatalar va vaqtni ko‘chish komponentlarining funksiyalari bo‘lib hisoblanadi.

2. Tadqiqot metodikasi

Kichik elastoplastik deformatsiyalar nazariyasiga ko‘ra, kuchlanish va deformatsiya tenzorining tarkibiy qismlari quyidagi munosabat bilan bog‘langan [1]:

$$\sigma_{ij}-\sigma\delta_{ij}=\frac{2\sigma_i}{3\varepsilon_i}(\varepsilon_{ij}-\varepsilon\delta_{ij}) \quad (1.1.1)$$

Bu yerda

$$\sigma=\frac{\sigma_{11}+\sigma_{22}+\sigma_{33}}{3} \quad (1.1.2)$$

Gidrostatik bosim;

$\varepsilon = \varepsilon_{11}+\varepsilon_{22}+\varepsilon_{33}$, δ_{ij}- Kroneker simvoli ($\delta_{ij}=1$ agarda i=j, $\delta_{ij}=0$ agarda i#j).

Tenglamaga kiritilgan kuchlanish intensivligi (σ_i) va deformatsiya intensivligi (ε_i) mos ravishda quyidagi formulalar bilan aniqlanadi:

$$\sigma_i=\frac{\sqrt{2}}{2}\sqrt{(\sigma_{11}-\sigma_{22})^2+(\sigma_{22}-\sigma_{33})^2+(\sigma_{33}-\sigma_{11})^2+6(\sigma_{12}^2+\sigma_{23}^2+\sigma_{13}^2)}$$

$$\varepsilon_i=\frac{\sqrt{2}}{3}\sqrt{(\varepsilon_{11}-\varepsilon_{22})^2+(\varepsilon_{22}-\varepsilon_{33})^2+(\varepsilon_{33}-\varepsilon_{11})^2+\frac{3}{2}(\varepsilon_{12}^2+\varepsilon_{23}^2+\varepsilon_{13}^2)}$$

Bu holda deformatsiya tenzorining elementlari quyidagicha ifodalanadi:

[a] https://orcid.org/0000-0001-8404-3013
[b] https://orcid.org/0009-0007-2900-0046
[c] https://orcid.org/0000-0002-1333-7361

$$\varepsilon_{ij}\begin{cases}\alpha_{ii}\frac{\partial u_i}{\partial x_i}+\sum_{\substack{j=1\\ i\#j}}^{3}\alpha_{ij}u_j & i=j,\\ \left(\alpha_{ii}\frac{\partial u_j}{\partial x_i}+\alpha_{jj}\frac{\partial u_i}{\partial x_i}\right)-(\alpha_{ij}u_i+\alpha_{ji}u_j) & (i,j=1,2,3)\\ & i\neq j,\end{cases}$$

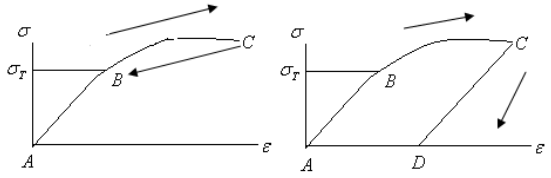
(1.1.3)

bu yerda

$$\alpha_{ij}=\begin{cases}\frac{1}{H_1} & i=j\\ \frac{1}{H_iH_j}\frac{\partial H_i}{\partial x_j} & (i,j=1,2,3)\\ & i\#j\end{cases}$$

H_i - Lame koeffitsiyentlari.

Elastiklikning chiziqli nazariyasida jismning deformatsiyasi paytida kuchlanish va deformatsiyalar o‘rtasida chiziqli bog‘liqlik kuzatiladi, deb taxmin qilinadi. Biroq, standart namunalarning diagrammasi cho‘zilishga sinalganda bizni ko‘pchilik materiallar uchun Guk qonuni faqat kichik deformatsiyalar hududida amal qilishiga ishontiradi. Namunalar uchun cho‘zilish sinovi diagrammasi rasmda ko‘rsatilganidek (1-rasm a,b). Shundan ma’lum bir *V* nuqtasidan boshlab σ va εorasidagi chiziqli bog‘liqlik buziladi [2].



1-rasm. Cho‘zilish sinovi diagrammalari: a) nochiziq elastiklik, b) elastoplastiklik.

Faraz qilaylik, namunani yuklashda kuchlanishlar C nuqtasiga mos keladigan qiymatga yetdi. Namunani keyingi yuklanishdan tushirish vaqtida ikkita imkoniyat paydo bo‘lishi mumkin. Bir holatda, tushirish diagrammasi SVA yuklash sxemasiga to‘g‘ri keladi va keyin yukni olib tashlangandan so‘ng, namuna asl holatiga qaytadi (1-rasm, a). Bunday materiallar nochiziqli elastik deb ataladi. Boshqa holatda, yuklanishdan tushirish diagrammasi *AV* diagrammasining dastlabki qismiga deyarli parallel bo‘lgan *CD* to‘g‘ri chiziq bilan mos keladi (1-rasm, b). Yukni olib tashlaganingizdan so‘ng, *AD* qismida namunaning qoldiq deformatsiyalar paydo bo‘ladi. Bunday materiallar elastoplastik deb ataladi.

Nochiziq elastik va elastikoplastik masalani yechish tenglamalarini qurish.

Nochiziqli elastik va elastoplastik materiallar o‘rtasida tubdan farq bor. Agar birinchi materiallar uchun berilgan deformatsiyalardan jismga ta’sir etuvchi kuchlanishlarni aniqlash imkonini beruvchi kuchlanishlar va deformatsiyalar o‘rtasida aniq bog‘liqlik mavjud bo‘lsa, u holda elastoplastik materiallar uchunσ ~εorasida aniq munosabat bo‘lmaydi, Berilgan deformatsiyaga asoslanib kuchlanishni faqat va faqat aniqlash mumkin, jismning oldingi qadamdagi kuchlanish-deformatsiyalanish holatini aniq bo‘lsa [3].

Shuning uchun plastiklik shartining holatini qandaydir kuchlaniish tenzori komponentlarining ma’lum bir funksiyasi sifatida yozish mumkin. Shubhasiz, izotropik material uchun plastik deformatsiyalarning paydo bo‘lishi sharti koordinatalar tizimini tanlashga bog‘liq bo‘lmasligi kerak. Unda ko‘rsatilgan funksiya kuchlanish tenzorining uchta invariantining funksiyasi bo‘lishi kerak, masalan, uchta bosh kuchlanishlarni olishimiz mumkin:

$$f(\sigma_1,\sigma_2,\sigma_3)=0 \qquad (1.1.4)$$

Elastik jism uchun uning yuklanish ketma-ketligi hech qanday rol o‘ynamaydi, chunki kuchlanish va deformatsiyalangan holatlar o‘rtasida bir qiymatli moslik mavjud, ularning qanday yaralishiga bog‘liq emas. Elastoplastik jismlarda vaziyat tubdan boshqacha bo‘lib chiqadi. Elastoplastik jism uchun nafaqat uning nuqtalaridagi kuchlanish holatining tabiati, balki u yaratilgan yo‘l ham muhimdir. Bunga bog‘liq ravishda, jismning bir xil nuqtalarida deformatsiyalangan holati sezilarli darajada o‘zgarishi mumkin [4].

Kuchlanish va deformatsiyalar, deformatsiyalar va ko‘chishlar o‘rtasidagi munosabatlardan foydalanib, berilgan jismning holati tenglamalarini quyidagicha ifodalash mumkin:

$$\rho\ddot{u}_i=\sum_{j=1}^{3}\frac{\partial}{\partial x_j}(\alpha_{jj}H\sigma_{ij})+\sum_{\substack{j=1\\ i\#j}}^{3}H(\alpha_{ij}\sigma_{ij}-\alpha_{ji}\sigma_{jj})+P_iH \quad (i=1,2,3) \qquad (1.1.5)$$

S_p va S_u sirtdagi chegaraviy shartlarga mos ravishda

$$(\sigma_{ij}-\sigma_{ij}^{*})\delta u_j\big|_{x_i=const}=0 \qquad (i,j=1,2,3) \qquad (1.1.6)$$

va boshlangich shartlar bilan

$$u_i|_{t=t_0}=\phi_i, \dot{u}i|_{t=t_0}=\psi_i \qquad (i=1,2,3) \qquad (1.1.7)$$

Deformatsiyalanuvchi jism mexanikasining ko‘rib chiqilgan tenglamalari sirtdagi shartlari va boshlang‘ich shartlari bilan birgalikda differensial shaklda elastiklik va plastiklik nazariyasi masalasining yakunlangan formulasini tashkil qiladi. Biroq, bu jismning kuchlanish-deformatsiyalanish holatini topish muammosining yagona mumkin bo‘lgan formulasi emas. Bunda $\vec{\sigma},\vec{\varepsilon},\vec{u}$ ni aniqlash masalasining holatni tavsiflashda, uni u yoki bu funksiyani aniq intergalini hisoblovchi funksional ko‘rinishga keltirish mamkin, funksiyaning o‘zi jismning haqiqiy holatini akslantiradi, shartdan bu funksionalni ekstremumini topish mumkin. Ushbu yondashuvning matematik apparati matematikaning variatsion hisobi deb ataladigan bo‘limida o‘rganiladi. Shuning uchun elastiklik va plastistiklik nazariyasidagi bunday funksionallarning xususiyatlarini shakllantiradigan qoidalar variatsion prinsip deb ataladi [5].

Muammoni bunday shakllantirishda ularning integrallash juda qiyin ko‘rinadi. Shuning uchun, differensial formulada masala mos ekvivalent variatsion formula bilan almashtiriladi:

$$\delta\int_{t_1}^{t_2}(T-\Pi+A)dt=0 \qquad (1.1.8)$$

Bu yerda

$$\delta T=-\int_v[\rho\sum_{i=1}^{3}\frac{\partial^2 u_i}{\partial t^2}\delta u_i]dV \qquad (1.1.9)$$

$$\delta\Pi=\int_v[\sum_{i=1}^{3}\sum_{j\#i}^{3}\sigma_{ij}\delta\varepsilon_{ij}]dV \qquad (1.1.10)$$

$$\delta A=\int_v\sum_{i=1}^{3}P_i\delta u_i dV+\int_s\sum_{i=1}^{3}q_i\delta u_i dS, \qquad (1.1.11)$$

ρ -material zichligi.

Aniq chegaraviy shartlarni va jismning geometriyasini, $\sigma-\varepsilon$bog‘lanishini, tashqi yuklarni berib va (Vlasov-Kantorovich, chekli ayirma va chekli elementlar) usullardan birini tanlash orqali qattiq jismni deformatsiyalash mexanikasining turli masalalarini yechishimiz mumkin.

Elastiklik va plastiklik nazariyasi muammosining variatsion shakllantirish

Elastiklik va plastiklik nazariyasi muammosining variatsion shakllantirish asosan ikkita holatda qo‘llaniladi. Birinchisida $\delta\int_{t_1}^{t_2}(T-\Pi+A)dt=0$ tenglama asosida masalani yechishning sonli usullari (Vlasov-Kantorovich, chekli ayirma va chekli elementlar usullari) quriladi [6]. Bu

usullarning barchasi elastiklik va plastiklik nazariyasidagi masalalarni yechishning to‘g‘ridan to‘g‘ri usullari sinfiga kiradi, ular aniq differensial tenglamalardan foydalanishni talab qilmaydi. Variatsion yondashuvni qo‘llashning ikkinchi holati ko‘rib chiqilayotgan masalaning differensial tenglamalari va chegara shartlarini mos funksional tenglamalar (1.1.8) sifatida olishdir. Bu yo‘l murakkab shakl va tuzilishga ega bo‘lgan jismlar uchun (masalan, ko‘p qatlamli qobiqlar va boshqalar), shuningdek, bir koordinata tizimidan ikkinchisiga (dekart tizimidan qutbli, egri chiziqli va boshqa tizimlarga) o‘tishda oqlanadi.

Vlasov-Kantorovich metodi jism ichidagi ko‘chishlarning taqsimlanishining taxminiy tabiati bilan berilgan. Kiritilgan yaqinlashuvchi funksiyalar noma’lum funksiyalar bo‘lib, ular ikkita koordinataga bog‘liqdir. Ushbu funksiyalarga nisbatan jami energiyani minimallashtirish oddiy differensial tenglamalar tizimiga olib keladi, keyingi integrallash bizga taxminiy ko‘chish maydonini olish imkonini beradi [7].

Hozirgi vaqtda elastoplastik uch o‘lchovli masalalar tenglamalarini taxminiy yechishda keng qo‘llaniladigan eng universal va samarali usullardan biri chekli ayirmalar usulidir. Usulning mohiyati quyidagicha. argumentlarning uzluksiz o‘zgarishi maydoni to‘r deb ataladigan diskret nuqtalar to‘plami (tugunlari) bilan almashtiriladi. Uzluksiz argument funksiyalari o‘rniga diskret argumentning funksiyalari ko‘rib chiqiladi, ular panjara tugunlarida aniqlanadi va to‘r funksiyalari deb ataladi. Differensial tenglama va chegara shartlariga kiritilgan hosilalar ayirma hosilalari bilan almashtiriladi; bu holda, differensial tenglama uchun chegaraviy masala chiziqli yoki chiziqli bo‘lmagan algebraik tenglamalar tizimi bilan almashtiriladi, ya’ni ayirma sxemalari.

Tenglamalarni yechish uslublari

Chekli elementlar usulida har bir chekli elementga tegishli tugunlarning ko‘chishlarini bilgan holda uning ichidagi ko‘chishlarni (shuning uchun deformatsiya va kuchlanishlarni) qanday topish mumkinligi haqida savol tug‘iladi. Uch o‘lchovli jism uchun muammoni taxminan hal qilish mumkin, agar elementdagi ko‘chish maydonining tabiati haqida ma’lum bir taxminlar amalga oshirilsa. Aniqrog‘i, ma’lum tugunli ko‘chishlar yordamida chekli element ichidagi ko‘chish maydonini yaqinlashtirish imkonini beruvchi ma’lum funksiyalar to‘plamini tanlash kerak. Uch o‘lchovli jismda elementlar orasidagi bog‘lanish nuqtalarining soni cheksiz bo‘lib, har bir element ichidagi ko‘chishlarning taqsimlanishi bilan beriladi va shu bilan uning barcha nuqtalarida, shu jumladan chegaralarda kuchlanishlarning taqsimlanishini o‘rganiladi. Binobarin, muvozanat shartlari butun sirt bo‘ylab bajarilishini ta’minlash mumkin emas [8]. Ushbu qiyinchilikni yengib o‘tish uchun har bir elementning chegarasi bo‘ylab ta’sir qiluvchi kuchlanishlar shartli ravishda ekvivalent xajmli tugun kuchlari bilan almashtirilishi mumkin; keyin tugunlarning ko‘chishlari yo‘nalishi bo‘yicha tugunlarning muvozanat tenglamalarini odatdagi usulda tuzish mumkin, shuningdek, sirt va hajm kuchlarini ularni energetik ma’noda ekvivalent bo‘lgan tashqi tugun kuchlari bilan almashtirish orqali hisobga olish mumkin. Ushbu soddalashtirishlarni kiritgandan so‘ng, jismni diskret tizim deb hisoblash mumkin, ya’ni. tugun nuqtalarida bir-biriga bog‘langan elementlar to‘plami sifatida.

Kutiladigan natija

Konstruksiyani sohalarga bo‘lish va ularning har biri uchun yaqinlashuvchi funksiyalarni tanlash turli usullar bilan amalga oshirilishi mumkin. Shu bilan birga jismning geometriyasining xususiyatlarini hisobga olish kerak va umuman butun jism uchun ko‘chishlar, deformatsiyalar va kuchlanishlarning yaxshi yaqinlashishini ta’minlash kerak. Bunday holda, chekli elementlar usuli yordamida olingan yechim chegarada elementlarning o‘lchamlari kamayishi bilan aniq bo‘lishga intiladi.

3. Xulosa

Ushbu maqola uch o'lchamli jismlardagi elastoplastik deformatsiyalar bilan bog'liq murakkab hodisalarni har tomonlama o'rganib chiqdi. Qattiq nazariy tahlil va raqamli simulyatsiyalar orqali biz moddiy xususiyatlar, yuklash shartlari va deformatsiya naqshlarining shakllanishi va evolyutsiyasini boshqaradigan geometrik konfiguratsiyalar o'rtasidagi murakkab o'zaro bog'liqlik aniqlandi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Rasulmuhamedov Muxamadaziz Muxamadaminovich	Toshkent davlat transport universiteti “Transportda axborot tizimlari va texnologiyalari” kafedrasi dotsentti. f.m.f.d (PhD), E-mail: prof.rasulmukhamedov@gmail.com Tel.: +998901205980 https://orcid.org/0000-0001-8404-3013
Shukurova Shohsanam Bahriddin qizi	Toshkent davlat transport universiteti “Transportda axborot tizimlari va texnologiyalari” kafedrasi

	doktaranti. E-mail: shoxsanamm2896@gmail.com Tel.: +998909607728 https://orcid.org/0009-0007-2900-0046	
Mirzaeva Zamira Maxamadaminovna	Toshkent davlat transport universiteti “Kopriklar va tonnellar” kafedrasi katta o`qituvchisi. E-mail: zmirzaeva83@mail.ru Tel.: +998903578301 https://orcid.org/0000-0002-1333-7361	

The effect of a multifunctional additive and a low-activity mineral filler on the formation of porosity and microstructure of a cement composite

A.I. Adylkhodjaev[1][a], I.A. Kadyrov[1][b], B.Sh. Kudratov[1][c], D.T. Azimov[1][d]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: The article examines the effect of a multifunctional additive and a low-activity mineral filler on the formation of porosity and structure of a cement composite. The multifunctional additive includes several active components that contribute to improving the properties of the cement matrix, whereas a low-activity mineral filler is used to regulate microstructure and porosity. In the course of the work, experimental studies were carried out, including the analysis of pore morphology and particle distribution using X-ray phase and differential thermal methods. Changes in the structure of the cement composite, its strength and durability were evaluated depending on the content and ratio of additives. The results showed that the combination of a multifunctional additive and a low-activity filler leads to a significant improvement in the mechanical properties and controlled porosity of the cement composite, which opens up new prospects for the development of more efficient building materials.

Keywords: complex modified concrete, non-heating technology, low-temperature technology, local raw materials, multifunctional additive, mineral filler, modification of concrete mixtures, ecology of construction

1. Introduction

In the construction industry, concrete and reinforced concrete structures are the most popular materials, both in terms of production volume and technical and economic characteristics. Concrete, recognized as the "material of the 20th century", continues to be the main construction material in the 21st century. Modern requirements for construction quality emphasize the need to use building materials that are not only low in cost and production costs, but also superior in performance to existing analogues.

In recent years, the international construction industry has seen the active development of low-energy technologies aimed at creating the "concrete of the future" using complex modifiers. This innovative approach solves current problems such as environmental safety, cost-effectiveness and rational use of resources. It also contributes to a significant improvement in the strength of concrete, reaching 70% or more in the early stages of hardening. Promising solutions include the use of complex modifiers, including polyfunctional additives and mineral fillers, which open up opportunities for the transition to resource-saving low-heating and non-heating technologies for the production of reinforced concrete products. This allows accelerating construction processes and obtaining cement composites with predetermined properties that meet modern requirements for strength, durability and environmental sustainability.

In the Republic of Uzbekistan, where the construction industry is developing rapidly, significant results have been achieved in the production of complex-modified concrete and reinforced concrete structures using highly effective additives. This has allowed not only to reduce the cost, but also to improve the quality and performance properties of cement concrete. The use of complex additives has become more effective, which is confirmed by numerous studies aimed at improving the reliability and durability of building materials. These studies help to increase the service life of structures and reduce operating costs. Practical recommendations are being developed to significantly improve the physical, mechanical and performance indicators of such materials. One of the key aspects in implementing these tasks is the improvement of existing technologies that ensure the grade strength of finished products and structures using resource-saving low-heating or no-heating methods. This is achieved through the combined use of mineral microfillers of technogenic origin and polyfunctional chemical additives. This article is devoted to the study of the effect of a polyfunctional additive and a low-activity mineral filler on the formation of porosity and microstructure of a cement composite.

2. Materials and research methods used

In the article, Portland cement CEMI 32.5N from the Akhangarancement plant was used as a binder, steelmaking waste from the Foundry and Mechanical Plant of JSC Uzbek Railways was used as a fine filler, and a new generation of highly effective superplasticizer based on polycarboxylate esters and ammonia water POLIMIXJBI and superplasticizer based on polycarboxylate esters POLIMIX from ARMENT CONSTRUCTION CHEMICALS were used as a chemical additive.

To evaluate the pore structure of cement systems, the mercury porosimetry method was used on a Thermo Scientific Pascal 240 EVO porosimeter. This method allowed for a detailed analysis of the distribution of pore sizes, total porosity and pore structure of cement stone. The porosimetric assessment was carried out on samples

[a] https://orcid.org/0000-0001-5729-5178
[b] https://orcid.org/0000-0003-3924-0864
[c] https://orcid.org/0000-0003-2603-1334
[d] https://orcid.org/0000-0002-2015-9663

maintained under standard temperature and humidity conditions, which ensured their representativeness.

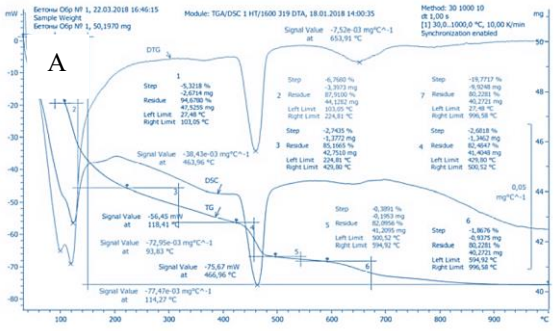
Differential thermal analysis was used to study the thermal properties of cement stone and assess phase changes during hardening. Samples of cement composites containing different ratios of a polyfunctional additive and a low-activity mineral filler were prepared for analysis. DTA was carried out on samples cooled and dried to a constant weight, which made it possible to determine the temperatures of the onset and end of phase changes, as well as to analyze the effect of additives on the thermal behavior of cement stone.

X-ray phase analysis was used to study the phase composition and crystal structure of cement stone. Samples for X-ray phase analysis included cement composites with var dditives, which allowed us to evaluate the effect of a p ıctional additive and a low-activity mineral filler on the formation of hydration phases. X-ray phase analysis was performed on powder samples of cement stone, which were pre-crushed to a certain particle size and placed under for X-ray analysis.

Thus, the use of the indicated research methods made it possible to comprehensively evaluate the effect of a multifunctional additive and a low-activity mineral filler on the porosity and microstructure of cement composites, providing valuable information for optimizing the composition and improving the characteristics of the cement material.

3. Results and discussions

To ensure a high strength level of modified cement stone with complex additives, a detailed study of its structure and phase changes during hardening is required. In this study, differential thermal (Fig. 1) and X-ray diffraction (Fig. 2) analysis of cement stone samples after 28 days of hardening were performed to evaluate the effect of various additives on the strength characteristics. As part of the experiment, the effect of ettringite phases at late stages of hardening was studied in samples with various additives, including fly ash (FA) and low-active steelmaking waste (LAW). The analysis was carried out for the following compositions: 1) reference composition based on Portland cement (PC); 2) PC with the addition of FA (30%); 3) PC with the addition of LAW (25%).



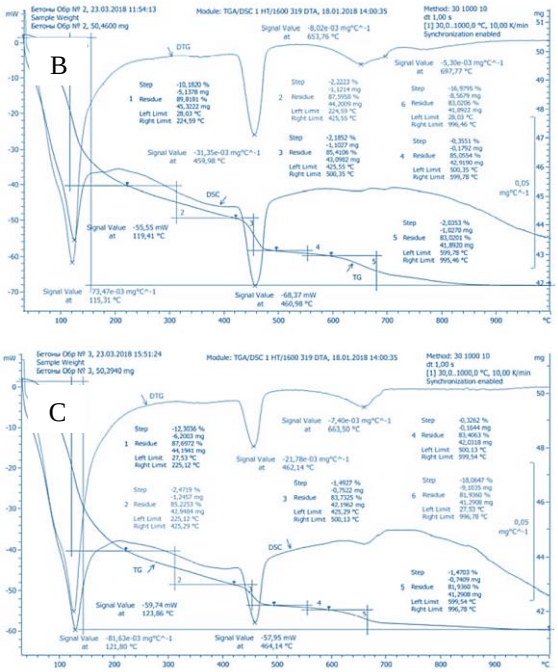


Fig. 1. Thermogram of the studied compositions. (A - reference composition from PC; B - PC+ZU (30%); C - PC+CDP (25%))

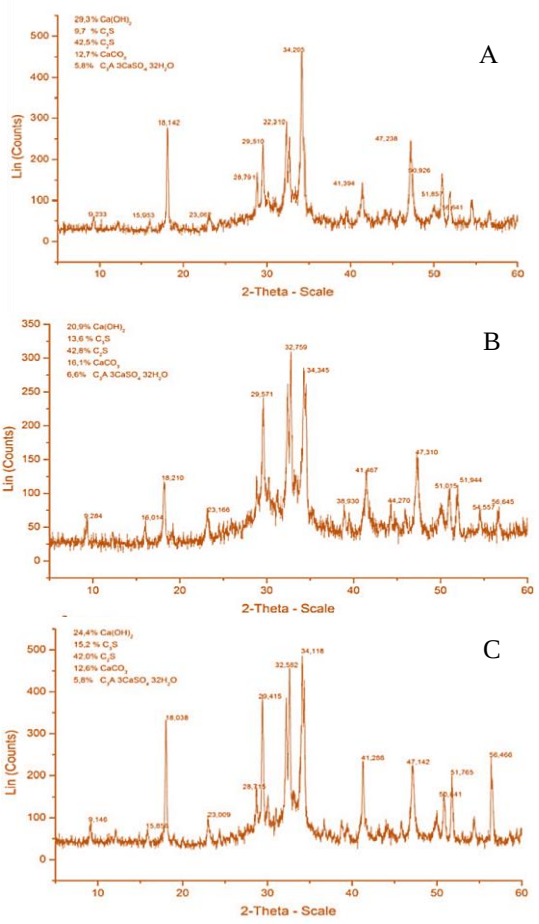


Fig. 2. Diffraction pattern of the studied compositions. (A - Reference composition from PC; B - PC + ZU (30%); C - PC + SLW (25%))

Analysis of Fig. 1 showed that the introduction of amorphous silicate into the cement composition contributed to a significant decrease in the amount of decomposing Ca(OH)2 during heating and increased the formation of new compounds due to the influence of amorphous silicon in the process of hydration of clinker cement. The greatest decrease in the amount of calcium hydroxide was observed in the modified composition with ZU, which is obviously associated with the active interaction of Ca(OH)2 with amorphous SiO2.

The analysis of diffraction patterns showed that amorphous silicate additives reduce the intensity of Ca(OH)2. In the control sample (Fig. 2A), the content of Ca(OH)2 was ~29.3%, and in composition No. 3 - ~23.7%. In the modified compositions with fly ash, an increase in the ettringite phase was observed from 5.8% to 6.6% due to a decrease in alkalinity and the formation of hydrosulfoaluminate minerals. This trend consists of a decrease in the content of Ca(OH)2 in the modified compositions compared to the standard, although in the compositions with FA the content of bound Ca(OH)2 is somewhat higher than in the samples with SLW.

In our opinion, this is not a disadvantage, since the decrease in the content of Ca(OH)2 does not lead to a significant decrease in the alkalinity of the cement stone and, as a result, the protective properties in relation to steel reinforcement in concrete increase significantly. Moreover, maintaining the required level of alkalinity of the pore fluid also helps to increase the resistance of the composite to sulfate and carbonation corrosion.

Numerous studies of the physical and mechanical properties of concrete, such as strength, deformability, permeability and frost resistance, have established a significant dependence of these characteristics on the size, configuration and number of pores in the material.

To study the porous structure of the studied compositions given in Table 4, studies were conducted using a Thermo Scientific Pascal 240 EVO mercury porosimeter (Table 1).

Studies of the porous structure of the compositions showed that the introduction of a complex additive affects the change in concrete porosity. In particular, the total porosity of composition No. 3 decreased by 20.25% compared to the control sample. The most significant decrease in porosity was recorded in composition No. 2, where the porosity of the modified composition based on NFA and SLW decreased by 30.11% compared to the control sample.

Comparison of the porous structure of different concrete compositions showed that the best reduction in all porosity indicators was observed in composition No. 2.

Operation of building structures at variable temperatures, including positive and negative values, leads to a decrease in the strength characteristics of heavy concrete due to thermal deformations and changes in the internal structure. One of the key factors affecting the durability of concrete is porosity. High porosity promotes water absorption, which increases the likelihood of damage during freeze-thaw cycles. Concrete with low porosity demonstrates better resistance to such effects.

Table 1

Indicators of the porous structure of the studied compositions

Name of indicators	Compound №1	Compound №2	Compound №3
Specific pore volume (mm^3/g):	63,81	46,78	49,24
Total pore area (m^2/g)	6,576	4,908	5,112
Average pore size (mkm):	0,0388	0,031	0,035
Total porosity of samples, %	14,91	10,42	11,89

4. Conclusion

X-ray diffraction and differential thermal analysis of the studied cement composites confirmed that the use of a complex modifier promotes enhanced hydration processes and the formation of high-strength calcium hydrosilicate compounds, which is associated with the effective binding of mineral calcium hydroxide with amorphous silicate. These changes lead to improved physical and mechanical properties of cement stone. In addition, it was found that the use of low-active SLW prevents the formation of the ettringite phase by maintaining a certain level of alkalinity in the cement composite. These results indicate that complex additives can significantly improve the performance characteristics of cement stone and contribute to its more stable and durable behavior. Analysis of the porosity indices of the studied cement composites demonstrated a significant decrease in the total porosity in the complex-modified composition. In particular, the total porosity of the reference composition decreased by 30.11% compared to the control composition, while the specific volume decreased by 26.68%. These results indicate an improvement in density and a decrease in porosity due to the use of modifiers. In comparison with the composition based on POLIMIX and SLW, the total porosity and volume porosity indicators were 12.3% and 4.9%, respectively. These data confirm the high efficiency of using NFA and SLW in reducing porosity and improving the structural properties of cement composites.

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Information about the authors

Adilxodjayev Anvar Ishanovich	Toshkent davlat transport universiteti “Bino va sanoat inshootlari qurilishi” kafedrasi professori t.f.d., E-mail: anvar_1950@mail.ru Tel.:+9989339831926 https://orcid.org/ 0000-0001-5729-5178
Kadirov Ilhom Abdullayevich	Toshkent davlat transport universiteti “Bino va sanoat inshootlari qurilishi” kafedrasi dotsent PhD, E-mail: ilhom.kadirov.1990@mail.ru Tel.:+9989973306119 https://orcid.org/0000-0003-3924-0864
Kudratov Bekzod Sherzodovich	Toshkent davlat transport universiteti “Bino va sanoat inshootlari qurilishi” kafedrasi tayanch doktoranti, E-mail: kudratov_bekzod@mail.ru Tel.:+998933983047 https://orcid.org/0000-0003-3924-0864 https://orcid.org/ 0000-0003-2603-1334
Azimov Doniyor To’ychi o’g’li	Toshkent davlat transport universiteti “Bino va sanoat inshootlari qurilishi” kafedrasi dotsent PhD, E-mail: Stalker.d12@gmail.com Tel.:+998974209688 https://orcid.org/ 0000-0002-2015-9663

Evaluation of the impact of automatic transmission vehicles on intersection capacity on urban arterial streets

J.A. Choriev[1][a], E.Z. Fayzullaev[1][b], A.S. Rakhmanov[1][c], N.N. Negmatov[1][d]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: This study focuses on analyzing the impact of automatic transmission vehicles on intersection throughput in urban arterial roads. The primary objective of the research is to assess the effect of automatic transmission vehicles on delay times and fuel consumption during the initiation of movement. The findings indicate that automatic transmission improves traffic flow at intersections, increasing overall throughput. The study's results can be applied to enhance traffic management systems and organize traffic flow more efficiently.

Keywords: Arterial street, intersection capacity, automatic transmission, vehicle, traffic flow, traffic management

1. Introduction

Traffic flow management and intersection permeability optimization is one of the urgent issues in modern urban planning and transportation engineering. Including the decision of the President of the Republic of Uzbekistan No. PQ-3589 dated March 6, 2018 "On measures to further improve the vehicle transport management system" increases the relevance of the research [1]. Increased traffic in fast-growing cities can cause problems with high volumes of vehicles at intersections. Automatic transmission vehicles are increasingly used on urban roads, but their impact on traffic delay time and reduced emissions has not yet been fully and accurately researched. Automatic transmission systems can reduce delay times at intersections and help reduce emissions, while providing quick acceleration and quick stopping capabilities. However, further research is needed to assess the effectiveness of this technology and determine its environmental impact. This study investigates and analyzes how automatic transmission vehicles affect traffic flow at intersections. This is important for the effective management and optimization of traffic flow in cities, as automatic transmission systems help to improve the efficiency of traffic flow and reduce delays at intersections.

Several studies have been conducted on automatic transmission vehicles and their effect on traffic flow. For example, (John Doe, 2016), (Maria Garcia, 2017), (Shinichi Takahashi, 2017), (Olga Ivanova, 2018), (Michael Brown, 2018), (Hassan Al-Mutairi, 2019), (Anna Schmidt, 2019), Researchers such as (Carlos Mendes, 2020), (Emily Zhang, 2021) and (Rahul Nair, 2022) also used simulation methods, statistical and experimental methods in modeling the impact of automatic transmission systems on traffic flow. However, there are still insufficient studies that have analyzed the specific effects of automatic transmission vehicles at intersections in depth. Some studies have evaluated the impact of automatic transmission vehicles by analyzing the overall traffic flow, but not enough attention has been paid to studying their specific impact at intersections .

Some of the shortcomings identified in the literature review include: insufficient research has been conducted to assess the impact of automatic transmission vehicle starting reaction times on traffic flow delays and fuel consumption at intersections. The impact of automatic transmission vehicles on the traffic process at intersections, how they disrupt traffic flow, and the negative effects of this situation on the transportation infrastructure have not been fully studied. Also, the effectiveness and practical application of the solutions developed on the basis of existing studies have not been fully evaluated.

Based on the identified problems, the main goal of the research is to evaluate the impact of the reaction time spent by the drivers of automatic transmission vehicles at intersections on city highways before starting the movement on traffic flow delay and fuel consumption. To achieve this goal, the research involves developing automatic transmission systems and methodologies, evaluating their effectiveness, and offering practical recommendations. The results of the research will help to reduce the level of congestion in cities, improve the permeability of intersections and reduce environmental damage, as well as help to develop practical recommendations that can be used in the field of traffic engineering and traffic management.

2. Materials and methods

The study was also conducted to determine the impact of automatic transmission vehicles on traffic flow at intersections and to estimate the amount of traffic delay and fuel consumption. The research was conducted in September 2023, at intersections on main streets of Karshi city.

During the implementation of the research, the amount of vehicles moving in the city and traffic flow at intersections was studied (Figure 1).

[a] https://orcid.org/0009-0009-9975-7444
[b] https://orcid.org/0009-0007-6294-9392
[c] https://orcid.org/0009-0003-0948-4347
[d] https://orcid.org/0009-0003-3140-3355

Figure 1. The process of installing measuring cameras to study the amount of traffic flow

The surveys were carried out by professional maintenance personnel and traffic engineers at identified intersections identified for the survey.

Statistical methods were used to analyze the research results. Based on the obtained data, parameters of the traffic flow at 23 intersections, which are the object of the study, were studied and analyzed, based on which methods were developed to evaluate the efficiency of the traffic flow. Compared with data from other studies, the impact of automatic transmission vehicles at intersections was calculated.

First of all, the delay time of the nth vehicle standing in one lane of the traffic flow standing at the red traffic light of the intersection from the time the green traffic light turned on was calculated using the following formula:

$$T_n = (n-1)\cdot t_r \quad (1)$$

Here: T_n - the delay time of the n-th automatic transmission vehicle from the time the traffic light turns on green, n - the n-th automatic transmission vehicle, t_r - the reaction time of the driver of the automatic transmission vehicle who went to start the movement.

The total delay time of vehicles with automatic transmission standing on one lane of the traffic flow was calculated by the following formula:

$$T_P = \frac{n \cdot T_n}{2} \quad (2)$$

Here: T_P - the total delay time of vehicles standing on one lane of the traffic flow, n is the automatic transmission vehicle in the nth place, T_n - is the delay time from the time the green traffic light of the nth automatic transmission vehicle lights up.

The total delay time of the traffic flow during one traffic light cycle of one intersection was calculated by the following formula:

$$W = \sum_{T_{P_m}}^{T_{P_1}} \left(T_{P_1} + T_{P_2} + T_{P_3} + \ldots + T_{P_m}\right) \quad (3)$$

Here: W - the total delay time of the traffic flow during one traffic light cycle of one intersection, T_P - is the total delay time of vehicles standing on one lane of the traffic flow, m is the total number of lanes of one intersection.

The formulas given above were applied using the corresponding values of the traffic flow parameters obtained from the 23 intersections that were the object of the study (Table 1).

Table 1

Traffic flow parameters at intersections

O/n	The name of the intersection	m – number of lanes	$n_{P_1} \ldots n_{P_m}$ – number of vehicles on each road section
1	Intersection of I.Karimov-Jayhun-Beyneu-Guzar highway	6	4, 6, 5, 14, 8, 16
2	Intersection of I.Karimov-Nasaf Khanabad streets	13	10, 10, 6, 7, 8, 7, 11, 10, 7, 8, 11, 12, 6
3	Intersection of I.Karimov-A.Timur streets	12	8, 9, 8, 12, 10, 11, 10, 12, 11, 6, 7, 7
4	Intersection of I.Karimov-Bunyodkor streets	9	15, 15, 9, 7, 14, 8, 10, 13, 10
5	Intersection of I.Karimov-Mustastilliq Streets	14	15, 13, 15, 14, 10, 11, 14, 11, 13, 12, 13, 14, 14, 15
6	Intersection of I.Karimov-Khanabad streets	11	3, 10, 5, 8, 14, 6, 7, 4, 8, 10, 6
7	Intersection of I.Karimov-Nasaf streets	15	4, 5, 7, 3, 13, 12, 14, 4, 4, 5, 6, 4, 4, 4, 5
8	Intersection of I.Karimov-Mashab streets	7	0, 0, 0, 0, 0, 0, 0
9	Crossroads of Nasaf-Kamandi streets	8	10, 10, 11, 4, 4, 6, 6, 4
10	Intersection of Nasaf-A.Timur streets	8	1, 2, 4, 10, 3, 4, 7, 4
11	Intersection of Nasaf-Bunyodkor streets	14	4, 2, 1, 3, 5, 6, 4, 3, 4, 4, 6, 5, 5, 4
12	Intersection of Nasaf-Mustazillik Streets	19	4, 7, 8, 10, 12, 10, 12, 10, 12, 5, 5, 8, 8, 8, 3, 3, 7, 4, 5
13	Crossroads of Nasaf-Guzor streets	5	6, 3, 3, 8, 7
14	Intersection of Nasaf-A. Navoi streets	12	3, 2, 1, 1, 4, 2, 1, 3, 3, 2, 1, 1
15	Intersection of Khanabad-A. Navoi streets	12	0, 3, 1, 3, 7, 2, 5, 5, 3, 4, 7, 6
16	Intersection of Mustaqilliq-A.Navoi Streets	16	4, 8, 7, 3, 2, 9, 10, 12, 7, 7, 8, 4, 5, 7, 6, 7,
17	Intersection of Olimlar-A. Navoi streets	7	9, 8, 5, 5, 8, 7, 7
18	Crossroad of Mashab-Guzor streets	6	6, 2, 3, 4, 4, 5
19	The intersection of Jayhun-Nasaf-A.Timur streets	13	7, 10, 14, 8, 13, 13, 11, 15, 13, 5, 7, 6, 7
20	The intersection of Jayhun-Olimlar streets	8	9, 8, 2, 5, 7, 9, 10, 6
21	The intersection of Jayhun-Mustaqilliq Streets	9	9, 10, 7, 4, 6, 4, 7, 8, 2

22	The intersection of Jayhun-Nasaf streets	6	4, 2, 4, 8, 8, 3
23	Jayhun-Khanabad street intersection	9	4, 7, 7, 8, 6, 9, 5, 8, 3

The locations of intersections selected as objects were marked on the map (Fig. 2).

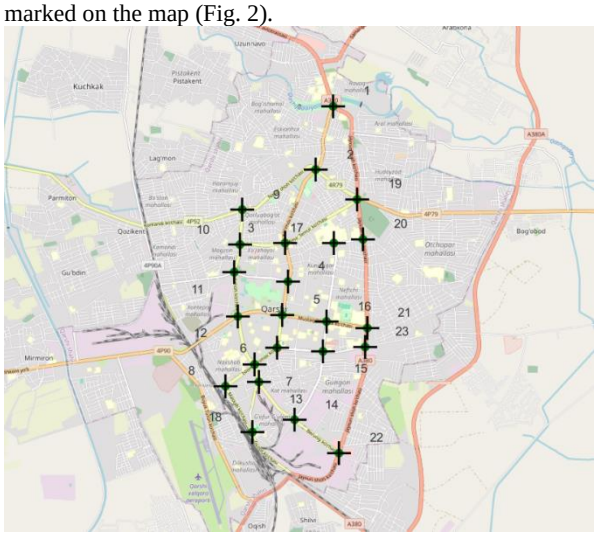

Figure 2. Intersections on the main streets of the opposite city

Vehicles with automatic transmission were also included as one of the objects of the study. The average reaction time of drivers of these vehicles is t_r - 0,7 seconds [3].

3. Results and discussions

Data collected during the study showed that vehicles with automatic transmissions had significantly reduced start-up delays at intersections. The following results were recorded:

First, the delay times of vehicles with automatic transmission standing in a suitable sequence on the same road were calculated using the above-mentioned formula (1) (Table 2).

Table 2

Delay times of automatic transmission vehicles in a matching sequence on the same lane

O/n	*n is* a vehicle with an automatic transmission standing in a proper sequence on one lane	*Tn* $_{is}$ the delay time (seconds) of a vehicle with an automatic transmission standing in a suitable sequence on one lane .
1	1	0
2	2	0,7
3	3	1,4
4	4	2,1
5	5	2,8
6	6	3,5
7	7	4,2
8	8	4,9
9	9	5,6
10	10	6,3
11	11	7
12	12	7,7
13	13	8,4
14	14	9,1
15	15	9,8
16	16	10,5
17	17	11,2
18	18	11,9
19	19	12,6
20	20	13,3

The values in the above table were used to calculate the total delay time of automatic transmission vehicles standing on the same lane (2).

Table 3

Total delay time of automatic transmission vehicles in a lane

O/n	P_m - the number of vehicles with automatic transmission standing in a suitable sequence on one road section	T_P - the total delay time of vehicles with automatic transmission standing on one lane (seconds)
1	1	0
2	2	0,7
3	3	2,1
4	4	4,2
5	5	7
6	6	10,5
7	7	14,7
8	8	19,6
9	9	25,2
10	10	31,5
11	11	38,5
12	12	46,2
13	13	54,6
14	14	63,7
15	15	73,5
16	16	84
17	17	95,2
18	18	107,1
19	19	119,7
20	20	133

For the 23 intersections that are the object of the study, the total delay times of automatic transmission vehicles accumulated during one traffic light cycle were calculated. In this case, the sum of the total delay times of vehicles with automatic transmission on each road section belonging to one intersection was calculated (3).

Table 4

Total delay times of automatic transmission vehicles calculated for each intersection

O/n	The name of the intersection	*m* – number of lanes	*W* - the total delay time of the traffic flow during one traffic light cycle of one intersection (minutes)
1	Intersection of I.Karimov-Jayhun-Beyneu-Guzar highway	6	3,15
2	Intersection of I.Karimov-Nasaf	1 3	5,36

	Khanabad streets		
3	Intersection of I.Karimov-A.Timur streets	12	5,6
4	Intersection of I.Karimov-Bunyodkor streets	9	6,46
5	Intersection of I.Karimov-Mustaqilig streets	14	13,23
6	Intersection of I.Karimov-Khanabad streets	11	3,58
7	Intersection of I.Karimov-Nasaf streets	15	3,96
8	Intersection of I.Karimov-Mashab streets	7	0
9	Crossroads of Nasaf-Kamandi streets	8	2,25
10	Intersection of Nasaf-A.Timur streets	8	1,02
11	Intersection of Nasaf-Bunyodkor streets	1 4	1,13
12	Intersection of Nasaf-Mustazillik Streets	19	6,24
13	Crossroads of Nasaf-Guzor streets	5	0,81
14	Intersection of Nasaf-A. Navoi streets	12	0,21
15	Intersection of Khanabad-A. Navoi streets	12	1,08
16	Intersection of Mustaqilliq-A.Navoi Streets	1 6	4,07
17	Intersection of Olimlar-A. Navoi streets	7	1,79
18	Crossroad of Mashab-Guzor streets	6	0,47
19	The intersection of Jayhun-Nasaf-A.Timur streets	1 3	7,53
20	The intersection of Jayhun-Olimlar streets	8	2,24
21	The intersection of Jayhun-Mustaqilliq Streets	9	2,08
22	The intersection of Jayhun-Nasaf streets	6	0,84
23	Jayhun-Khanabad street intersection	9	1,96

The obtained results clearly showed the positive effect of vehicles with automatic transmission on traffic efficiency at intersections. Fast acceleration and smooth movement of vehicles have significantly reduced delay times. These results are important for the development of measures to improve the city's transport infrastructure and optimize traffic flow. The reduced lag time of automatic transmission vehicles allows for more efficient traffic control and helps increase overall throughput.

The methodology and measurement methods used in the research ensured the validity of the results. Data collected through experimental methods were accurate and objective and accurately reflected the relationship between traffic flow and delay time. Statistical analysis confirmed the significance of the results, which increased the reliability of the conclusions.

One of the main limitations of such studies may be possible errors in the data collection process and limited selection. For example, some intersections in the table show a delay time of zero, which may be the result of data inaccuracy or measurement error. Therefore, future studies are recommended to increase the accuracy of the data and cover a wider range of intersections as possible.

Based on the results obtained during the research, the positive effect of vehicles with automatic transmission on traffic at intersections was clearly demonstrated. The rapid acceleration and deceleration of vehicles with automatic transmission systems has significantly improved efficiency, especially at intersections with multiple lanes. For example, at the intersection of I.Karimov-Mustaqilliq streets, there are a total of 14 road sections, and the accumulated delay time of vehicles in the traffic light cycle was more than 13 minutes. If these intersections have a greater presence of automatic transmission vehicles, the total delay time is significantly reduced, which will optimize traffic flow and increase road capacity. Thus, widespread adoption of automatic transmission vehicles is essential to improve traffic flow and reduce delays.

Through the results of the study, the economic damage of the problem was also calculated. The total delay time of each of 1627 vehicles during one traffic light cycle at 23 selected intersections was 75 minutes (1 hour 15 minutes). Table 5 below shows the economic cost of fuel wastage as a result of the delay time.

Table 5
The economic cost of delay due to wasted fuel

O/n	Type of fuel	Fuel price (soums / liter)	Fuel consumption (liter)	Average economic damage (soums)
1	Methane	3,500 - 4,000 soums/m³	1,125-2,25	6 328
2	Propane	5,500 - 6,500	1,5-3	13,500
3	Ai-80 gasoline	6,500 - 7,500	3,75-7,5	39 375
4	Ai-91 gasoline	10,500 - 12,000	3,75-9	71 718
5	Ai-95 gasoline	13,500 - 15,000	4,5-9,75	101 531
6	Diesel fuel	12,000 - 14,000	3-7,5	68 250

The above economic losses are generated by vehicles with automatic transmission only during one traffic light cycle. Now, if we calculate these values in terms of hours, days, weeks and months, it is clear that the economic damage will be even greater. Although automatic transmission vehicles are quicker to move, have relatively less lag time and fuel consumption, even when these vehicles are operating optimally, fuel consumption and emissions are detrimental to the environment. Taking into account the fact that Tashkent city ranks high among world cities in terms of air pollution, it is necessary to emphasize the need to reduce air pollution by using automatic transmission cars more effectively.

4. Conclusion

This study is aimed at studying the influence of automatic transmission vehicles on the traffic of intersections on the main streets of the city, and serves as an important basis for scientific work in this regard. The obtained results showed that automatic transmission vehicles play an important role in significantly reducing traffic delay time and improving the efficiency of traffic flow. The study assessed the impact of automatic transmission vehicles on the delay time and fuel consumption, and identified the economic and environmental damages of this process. In particular, as these vehicles started to move faster at intersections, the negative impact on road flow was reduced and road capacity increased. Also, the research results can be applied in the fields of transport engineering and traffic management. This research has a scientific basis that can contribute to the improvement of urban infrastructure and efficient management of traffic flow.

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Information about the authors

Jahongir Choriev	Doctoral student of Tashkent State Transport University, "Intelligent Transport Systems Engineering" department . E-mail: jahongirc9@gmail.com Phone: +998942949402 https://orcid.org/0009-0009-9975-7444
Erkin Fayzullaev	"Vehicle Engineering" department of Tashkent State Transport University, acting professor E-mail: erkin.fayzullayev@gmail.com Phone: +998909567585 https://orcid.org/0009-0007-6294-9392
Azimjon Rakhmanov	Senior teacher of the "Intelligent Transport Systems Engineering" department of Tashkent State Transport University. (PhD), E-mail: azimjonrahmonov81@gmail.com Phone: +998974308920 https://orcid.org/0009-0003-0948-4347
Navruz Negmatov	Assistant of the "Intelligent Transport Systems Engineering" department of Tashkent State Transport University. E-mail: navroʻznegmatov101@gmail.com Tel.:+998996263267 https://orcid.org/0009-0003-3140-3355

Formation of strategic planning in improving the management system of Tashkent State Transport University

S.A. Uktamov[1][a], G.E. Pulatova[1][b], G.D. Talipova[2][c]
[1]Tashkent state transport university, Tashkent, Uzbekistan
[2]Tashkent transport college, Tashkent, Uzbekistan

Abstract: In developed countries or large companies, long-term development programs rely on the development of human capital. At the same time, investment in education is also increasing year by year. As a result, the demand for education increases. This requires the institutions providing educational services to constantly improve the management system. The most effective way to improve the management system is to make correct and timely management decisions. The effectiveness of management decisions depends on a long-term plan, that is, a strategic plan for the development of the institution.

Keywords: strategic planning model, transport enterprises, public transport, strategic planning, market conjuncture

Toshkent davlat transport universitetining boshqaruv tizimini takomillashtirishda strategik rejalashtirishni shakllantirish

Uktamov S.A.[1][a], Pulatova G.E.[1][b], Talipova G.D.[2][c]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston
[2]Toshkent transport texnikumi, Toshkent, O‘zbekiston

Annotatsiya: Rivojlangan davlatlarda yoki katta kompaniyalarda uzoq muddatli rivojlanish dasturlari inson kapitalini rivojlanishiga tayanmoqda. Shu bilan birga, ta’lim kiritilayotgan investitsiya ham yildan yilga ortib bormoqda. Buning natijasida ta’limga bo‘lgan talabni ortishiga olib kelmoqda. Bu esa ta’lim xizmatini ko‘rsatuvchi muassasalardan boshqaruv tizimini doimiy ravishda takomillashtirishni taqozo etadi. Boshqaruv tizimini takmillashtirishni eng samarali yo‘li boshqaruv qarorni to‘g‘ri va o‘z vaqtida qabul qilishdir. Boshqaruv qarorlarni samaradorligi esa uzoq muddatga qaratilgan reja, ya’ni muassasani rivojlantirish strategik rejasiga bog‘liqdir.

Kalit so‘zlar: strategik rejalashtirish modeli, transport korxonalari, jamoat transporti, strategik rejalashtirish, bozor konyukturasi

1. Kirish

Universitetni ta’lim xizmatlari bozori talablariga mos holda faoliyat olib borishi uchun xavflarni boshqarish tizimi, KPI, manfaatlar muvozanatini saqlashga asoslangan strategiyani shakllantirishni talab qiladi. Chunki, universitetning strategik rivojlanish rejasi ta’lim, ilmiy va boshqaruv faoliyatini belgilaydi[1].

Universitetning strategik rivojlanish rejasi ustuvor yo‘nalishlari mintaqaviy xususiyatlarni hisobga olgan holda universitetning tashqi va ichki muhitini tahlil natijasida belgilandi va universitet faoliyatini boshqarish jarayonlarini izchil va tizimli takomillashtirishni ta’minlaydi. Shu sababli, Toshkent davlat transport universitetini boshqaruv tizimini va uning samaradorligini oshirish uchun uzoq muddatga mo‘ljallangan strategik rivojlanish rejasini shakllantirish maqsadga muvofiqdir. Quyida Toshkent davlat transport universitetining strategik rivojlanish rejasini shakllantirishda amaliy takliflarni keltirib o‘tamiz[1,15].

1- jadval
Universitetning strategik yo‘nalishlari

Strategik yo‘nalishlar	**Strategik yo‘nalishlar mazmun va mohiyati**
Milliy iqtisodiyotni rivojlanish darajasidan kelib chiqib kadrlar tayyorlash	O‘zbekiston Respublikasi milliy iqtisodiyoti rivojlanish tendensiyasiga asosan xalqaro standartlarga muvofiq, yuqori kompetensiyalarga ega malakali mutaxassislarni tayyorlashni ta’minlash.
Barqaror ilmiy-tadqiqot tizimini takomillashtirish	Iqtisodiyotning real sektori talablaridan kelib chiqqan holda ilmiy-tadqiqot ishlarini kengaytirish va tijoratlashtirish darajasini oshirish
Universitetni xalqarolashtirish	Milliy va xalqaro talablarni hisobga olgan holda texnik mutaxassislarning tayyorlashda o‘quv jarayonini xalqarolashtirish

[a] https://orcid.org/0009-0006-0298-9475
[b] https://orcid.org/0009-0006-6358-624X
[c] https://orcid.org/0009-0001-1567-1822

Ijtimoiy rivojlanish	Yoshlar o‘rtasida milliy ma’naviy-axloqiy qadriyatlarni saqlab qolish
Samarali boshqaruv va korporativ madaniyatni takomillashtirish	Universitet faoliyatini boshqarish va korporativ madaniyatning yuqori darajasiga erishishning samarali tizimi rivojlantirish.

Universitetning strategik yo‘nalishlari amalga oshirishga qaratilgan strategik rivojlanish rejasi ishlab chiqish uchun eng avvalo universitetning kuchli, zaif va imkoniyatlarini, ya’ni SWOT-tahlilini amalga oshirish kerak. Amalga oshirilgan universitet faoliyati tahlili natijalari asosida universitetning SWOT-tahlili jadvali quyidagi ko‘rishga ega[14].

2. Metodologiya

2- jadval

Toshkent davlat transport universiteti SWOT-tahlili

T/r	S(strengths) – Kuchli tomonlar (ijobiy ichki omillar)
1	2
1.	Texnik sohada kadrlar tayyorlashda o‘z mavqega egaligi
2.	Bitiruvchilarni ish bilan ta’minlashning yuqori darajasi
3.	Akademik siyosatni talabalar ehtiyojlariga yo‘naltirilganligi;
4.	Akademik mobillik dasturlarini amalga oshirish imkoniyati mavjudligi;
5.	“2+2” o‘zaro ta’lim dasturlarini mavjudligi;
6.	Xalqaro darajadagi turli markazlar mavjudligi;
7.	Ta’lim jarayoniga yirik kompaniyalar vakillarini jalb etilishi;
8.	Professor-o‘qituvchilar va xodimlarni moddiy rag‘batlantirish mexanizmlarining mavjudligi;
9.	Universitetning moddiy-texnik bazasini yangilash va mustahkamlash;
10.	Zarur shart-sharoitlar yaratish orqali xavfsiz va qulay o‘quv muhitini ta’minlash;
11.	O‘quv texnikasi va kompyuter texnikasini har yili yangilab borish;
12.	Tarbiyaviy ishlarga katta e’tibor qaratilish.
13.	Ilmiy laboratoriyalar va markazlar mavjudligi;
14.	Monografiyalar va patentlar, nufuzli jurnallarda nashrlar sonining ko‘payishi, nashrlarning iqtiboslar darajasining oshishi;
15.	Ilmiy darajalar beruvchi ilmiy kengashlarining mavjudligi;
16.	Xorijiy va mahalliy professor-o‘qituvchilarini ixtisoslashtirilgan fanlar bo‘yicha konsultatsiyalar va imtihonlar o‘tkazishga jalb etishi;
17.	Yaqin va uzoq xorij olimlari bilan barqaror ilmiy aloqalar mavjudligi;
18.	Yuqori impakt faktorli jurnallardagi nashrlar mavjudligi;
19.	OAK e’tirof etgan ilmiy jurnallarni mavjudligi;
20.	Professor-o‘qituvchilar tomonidan yaratilgan o‘quv adabiyotlariga grif berish huquqi mavjudligi.
	W(weakness)- Kuchsiz tomonlari (salbiy ichki omillar)
1.	Pedagogik kadrlar sifatining pasayishi, o‘z-o‘zini rivojlantirish va o‘qitishda yangi texnologiyalarni joriy etish uchun shaxsiy motivatsiyaning kamligi;
2.	Professor-o‘qituvchilar va talabalarning ingliz tilini bilish darajasining yetarli darajada yuqori emasligi;
3.	Professor-o‘qituvchilarning ingliz tilida texnik fanlarni o‘qitish metodikasini bilish darajasining pastligi;
4.	Xorijiy talabalar yetarli darajada jalb etilmaganligi;
5.	Turli akademik dasturlarini universitet hisobidan moliyalashtirishning yetarli darajada emasligi;
6.	Virtual laboratoriyalar sonining yetarli emasligi.
7.	Xalqaro ta’lim ko‘rgazmalari va loyihalarida ishtirok etishning past darajasi;
8.	Elektron ta’lim mazmunini rivojlantirish bo‘yicha professor-o‘qituvchilarning raqamli ko‘nikmalarining yetarli darajada emasligi;
9.	Qo‘shma ta’lim dasturlari va Double Degree dasturlari sonining yetarli emasligi.
10.	Rivojlanishni istamaslik, mavjud muammolarni inkor etish, shaxsiy o‘sishga yo‘naltirilmaslik;
11.	Tahlil va jarayonlar monitoringining yagona axborot tizimining mavjud emasligi;
12.	Kutubxona fondi asosan boshqa tilida;
13.	Kompleks axborot xavfsizligi tizimining yo‘qligi;
14.	Universitet mobil ilovalarining etishmasligi;
15.	Professor-o‘qituvchilarning ilmiy loyihalardagi ishtirokining pastligi;
16.	ilmiy tadqiqotlar uchun to‘g‘ridan-to‘g‘ri xalqaro moliyalashtirishning yo‘qligi;
17.	professor-o‘qituvchilar orasida tadbirkorlik va tadqiqotchilik ko‘nikmalarining yo‘qligi;
18.	innovatsiyalarni tijoratlashtirishning yetarli darajada rivojlanmaganligi;.
19.	ilmiy-tadqiqot infratuzilmasidan yetarli darajada foydalanilmayotganligi
	O(opportunities) – Imkoniyatlar (ijobiy tashqi omillar)
1.	milliy va xalqaro reytinglarda o‘rinlarni yaxshilash;
2.	akademik mobillik yangi yo‘nalishlarini, shu jumladan xorijiy davlatlar bilan hamkorlikni rivojlantirish;
3.	xalqaro ta’lim xizmatlari bozorida universitetning ijobiy imijini yaratish;
4.	chet ellik talabalar ulushini oshirish;
5.	professor-o‘qituvchilarning xalqaro ta’lim loyihalarida ishtirok etishi;
6.	hudud ehtiyojlariga mos ravishda talabalar sonining maqsadli shakllanishi
7.	mutaxassislar tayyorlash jarayoniga yangi ta’lim texnologiyalarini joriy etish
8.	bitiruvchilarni tayyorlash darajasidan ish beruvchilarning qoniqishini oshirish
9.	universitet brendini rivojlantirish
10.	bitiruvchilar uyushmasini rivojlantirish;

11.	boshqaruv va kommunikativ ko‘nikmalarni rivojlantirishda ma’muriy xodimlarning malakasini tizimli ravishda oshirish
12.	xorijiy hamkorlar bilan hamkorlikda ilmiy tadqiqotlarni rivojlantirish
13.	tadqiqot natijalarini xalqaro miqyosda taqdim etish
14.	uch tomonlama shartnomalar (universitet-ilmiy tashkilot-biznes) tuzish orqali ilmiy loyihalarni amalga oshirish
15.	nashrlarning iqtibos darajasini oshirish
16.	yetakchi xorijiy ilmiy parklar tomonidan taqdim etilgan hamkorlar sonini ko‘paytirish
17.	ilmiy tadqiqotlarni amalga oshirish uchun yangi sarmoyaviy sheriklarni jalb qilish
18.	ilmiy klasterlar maqsadlariga muvofiq universitet infratuzilmasini modernizatsiya qilish
	T (Threats) – Xavf (salbiy tashqi omillar)
1.	ta’lim xizmatlari bozorining global tendensiyalariga bog‘liqligi
2.	universitetlar o‘rtasidagi raqobat kuchayishi
3.	magistratura uchun grantlar sonini qisqartirish
4.	abituriyentlarning xorijiy universitetlarga ketishi
5.	QS hamkorlarining o‘sib borayotgan reytingi
6.	talabalar grantlari, ilmiy tadqiqotlar va kadrlar malakasini oshirish uchun mablag‘ va resurslarning etishmasligi
7.	raqamli ta’lim tizimlarini qo‘llab-quvvatlash tizimlarining nomukammalligi
8.	xalqaro amaliyotni hisobga olmagan holda yangi va innovatsion ta’lim dasturlarini ishlab chiqish
9.	o‘qitiladigan yo‘nalishlar bo‘yicha bilimlarning eskirganligi
10.	Kadrlar tayyorlashning amaldagi tizimi, oliy o‘quv yurtlarining moddiy va infratuzilma resurslari manfaatdor tomonlar, shu jumladan ish beruvchilar talablariga javob bermayapti
11.	mutaxassislarning malaka darajalari uchun mavjud malaka talablari ishlab chiqarishning yangi texnologiyalariga mos kelmasligi
12.	iqtisodiyot tarmoqlarida kadrlarga bo‘lgan ehtiyojni bashorat qilishda mehnat resurslarining nomutanosibligi
13.	vertikal va gorizontal axborot oqimlari uchun aniq reglamentlarning yo‘qligi, bu esa axborotni tarqatish samaradorligining pasayishiga olib keladi
14.	davlat tomonidan moliyalashtirishning qisqarishi
15.	universitetlar tomonidan real ishlab chiqarish uchun taklif etilayotgan ilmiy tadqiqotlar va amaliy ishlanmalarning samaradorligi va samaradorligini pasaytirish
16.	texnologik ishlanmalar tufayli laboratoriya jihozlarining eskirganligi
17.	universitetning moliyaviy barqarorligining pasayishi hisobiga laboratoriya jihozlarini sotib olish xarajatlarini kamaytirish

Universitet faoliyatidan kelib chiqib, universitetning strategik yo‘nalishlari, kuchli, zaif, imkoniyatlari hamda xatarlarni aniqlagandan so‘ng, universitet strategik rejasini ishlab chiqish uchun universitet missiyasi, kelajakdagi niyatlari (videniya), shiori hamda qadriyatlarini belgilab olishi lozim[2,3].

Toshkent davlat transport universitetning asosiy maqsad va vazifalari jahon darajasidagi ta’lim berish (xalqaro standartlarga javob beradigan sifatli ta’limni taqdim etish, transport sanoatining hozirgi va kelajakdagi muammolariga samarali hal qila oladigan oladigan mutaxassislarni tayyorlash), innovatsiyalar va tadqiqotlar olib borish (universitet transport tizimini takomillashtirish, atrof-muhitga ta’sirni kamaytirish va xavfsizlikni oshirishga qaratilgan ilmiy tadqiqotlar va innovatsion loyihalarni faol ishtirok etish), xalqaro hamkorlikni kuchaytirish (tajriba almashish uchun yetakchi universitetlar, ilmiy markazlar va sanoat korxonalari bilan xalqaro aloqalar va hamkorlikni kengaytirish), atrof-muhit barqarorligiga hissa qo‘shish (dasturlarimiz va tadqiqotlarimiz atrof-muhitni muhofaza qilishga qaratish va ekologik toza transport yechimlarini ishlab chiqish), amaliy yo‘nalishlarni takomillashtirish (sanoat bilan yaqin hamkorlikni davom ettirish, talabalarga amaliy mashg‘ulotlar va real loyihalarda ishtirok etish imkoniyatini yaratish), texnologik liderlikka erishish (o‘qitish va tadqiqotlarni amalga oshirishda ilg‘or texnologiyalar va raqamli vositalardan, jumladan, sun’iy intellekt, katta ma’lumotlar bazasi va avtomatlashtirishdan foydalanish) ijtimoiy mas’uliyat (jamiyat hayoti sifatini yaxshilaydigan va ijtimoiy inklyuziyani rag‘batlantiradigan transport yechimlarini yaratish), kasbiy o‘sishni ta’minlash (qo‘shimcha ta’lim va kasbiy qayta tayyorlash dasturlari orqali o‘quvchilar va xodimlarning doimiy malakasini oshirish), inklyuzivlik va tenglik (Universitet barcha talabalar va xodimlar uchun, ularning kelib chiqishi, jinsi yoki boshqa farqlaridan qat’i nazar, inklyuziv va qo‘llab-quvvatlovchi muhit yaratish) iborat ekanligidan kelib chiqib, bizning fikrimizga ko‘ra[11,13].

3. Natijalar

Universitet missiyasi: Toshkent davlat transport universiteti O‘zbekiston va Markaziy Osiyo ravnaqi uchun zarur bo‘lgan barqaror va samarali transport infratuzilmasini rivojlantirishga hissa qo‘shuvchi ilg‘or ta’lim muassasasi bo‘lishga intiladi.

Universitet kelajakdagi niyatlari (videniya): Toshkent davlat transport universiteti an’ana va innovatsiyalar yonma-yon yuradigan, transport va logistikani barqaror rivojlantirish uchun zamin yaratadigan kadrlar tayyorlovchi maskandir[5,7].

Universitet shiori: Qadriyatlar va an’analarni saqlagan holda, transport kelajagini qurish.

Universitet qadriyatlari:

1. Ma’naviy yetuk: Insoniy qadriyatlar, ma’naviy boylik, yoshlar tarbiyasi, vatanparvarlik ruhini shakllantirish, milliy o‘zlikni asrash.
2. Do‘stlik, tenglik va bag‘rikenglik: Universitet o‘zining barcha faoliyati do‘stlik, tenglik asoslanadi va o‘zaro bag‘rikenglikni qo‘llab-quvvatlaydi.
3. Shaffoflik. Ta’lim faoliyati vijdonan amalga oshiriladi.
4. Kasbiylik: Yuqori malakali, intizomli professor-o‘qituvchilarning kasbiy mahorat darajasi - talabalarni rivojlantirishga qodir.
5. Innovatsiya: o‘qituvchining ijodiy faolligi orqali o‘qitishning yangi usullarini shakllantirish, yangi rejalar

tuzish, turli muammolar yechimini loyihalash, bilimlarni egallashga erishish.

Toshkent davlat transport universiteti O‘zbekiston oliy ta’lim tizimida yetakchi o‘rinni egallashi uchun, yuqorida keltirilgan fikrlar asosida strategik rivojlanish rejasining shakllantirish quyidagi tamoyillarga asoslanishi shart[4,8].:

1. Uzluksiz ta’lim — bo‘lajak mutaxassislarning ilmiy tadqiqot va ishlab chiqarishni barqaror rivojlantirish bilan bog‘liq kompetentsiyalarini maqsadli rivojlantirish.

2. Ilmiy, ishlab chiqarish va o‘quv jarayoni subyektlarining jamoaviy mas’uliyati - turli tarmoqlarida talab qilinadigan malakali, ijodiy fikrlash va tadbirkorlik ko‘nikmalariga ega kadrlarni tayyorlashdan iborat.

3. Uzoq muddatli rejalashtirish — iqtisodiyot tarmoqlarining rivojlanishini hisobga olgan holda muhandislik-texnik xodimlarga bo‘lgan ehtiyoj darajasini izchil baholash.

4. Inson kapitalini rivojlantirish – ilmiy-pedagogik kadrlarni innovatsion iqtisodiyot uchun zarur bo‘lgan vakolatlar tarkibiga muvofiq maqsadli, uzluksiz va tizimli rivojlantirish.

5. Kafolatlangan talab – mehnat bozori ehtiyojlarini qondirishga qaratilgan kadrlar tayyorlash.

6. Korporativ boshqaruv — vakolatlarni taqsimlash va ta’lim jarayonining barcha ishtirokchilarining umumiy mas’uliyatini belgilash bo‘yicha ta’lim tashkilotining prinsipial jihatdan yangi siyosatini amalga oshirish.

7. O‘quv-ishlab chiqarish muhitini modernizatsiya qilish – ta’lim tashkilotlarining mavjud o‘quv va ilmiy laboratoriyalarini, axborot resurslarini ishlab chiqarishning asosiy ehtiyojlariga maqsadli muvofiqlashtirish[6]..

Hozirgi kunda oliy ta’lim massalarni mavqeyini belgilovchi omillardan biri ta’lim muassasalarini reytingi hisoblanadi. Ma’lumki O‘zbekiston Respublikasida faoliyat olib borayotgan oliy ta’lim muassasalarini reytingi ikki turga mahalliy va xalqaro reyting tizimiga bo‘linadi. Bu ikki tizim universitetni reytingini aniqlashda bir biriga juda yam yaqin mezonlarga asoslanadi. Mahalliy reytingda ham yuqori o‘rin egallash uchun xalqaro reyting talablarini bajarish bizning fikrimizcha yetarli. Shu sababli, Times Higher Education xalqaro reyting tashkiloti tomonidan ta’lim massasini reytingini aniqlashda foydalaniladigan umumiy o‘qitish, ilmiy tadqiqotlar, iqtiboslar, xalqaro istiqbol, sanoat daromadi (har bir ko‘rsatkich individual ko‘rsatkichlarga taqsimlanadi) ko‘rsatkichlarini bajarish talablari, universitet missiyasi, kelajakdagi niyatlari (videniya), shiori, qadriyatlari va strategik rivojlanish rejasining shakllantirish quyidagi tamoyillari hamda universitet tashki va ishchi muhiti tahlillari asosida universitet strategik rejasi va uning samaradoriligini oshirish maqsadida Times Higher Education xalqaro reytingda o‘ring egallashi uchun amalga oshirilishi zarur bo‘lgan dasturni taklif etamiz (3.3- jadval). Ushbu dasturni amalga oshirish orqali universitetni xalqaro reytingdagi o‘rnini oshirishiga ҳамда quyidagi ko‘rsatkichlar ijobiy o‘zgarishга olib келади[9,10].:

1. Talabalar oqimining ko‘payishi: Universitetni xalqaro reytingdagi o‘rni yuqorilashishi, universitet jozibadorligini oshirishga imkon yaratishi orqali, universitetni taniqlilik darajasini oshiradi, natijada chet eldan ko‘proq talabalarni jalb qiladi.

2. Moliyalashtirish va investitsiyalar o‘sishi: Yuqori darajadagi universitetlar ko‘proq davlat va xususiy moliyalashtirishni jalb qilishlari mumkin. Investorlar va homiylar muvaffaqiyatli va nufuzli ta’lim muassasalariga sarmoya kiritishni afzal ko‘rishadi.

3. Malakali o‘qituvchilar va tadqiqotchilarni jalb qilinishi: Nufuzli universitetlar yuqori malakali o‘qituvchilar va tadqiqotchilar uchun birinchi darajali tanlov omilidir.

4. Xalqaro hamkorlikni mustahkamlashi: Reytinglardagi yuqori o‘rinlar jahonning yetakchi universitetlari bilan hamkorlik aloqalarini o‘rnatishga yordam beradi, bu esa qo‘shma loyihalar, almashinuv dasturlari va hamkorlikning boshqa shakllarini amalga oshirish imkoniyatini yaratadi.

5. Ijobiy imij: Universitetni barcha tan oladi. Bu nafaqat universitet, balki uning bitiruvchilari obro‘siga ham ijobiy ta’sir ko‘rsatadi.

6. Bitiruvchilarning ish bilan ta’minlanishini oshirishi: Ish beruvchilar ko‘pincha yuqori reytingga ega oliy o‘quv yurtlari bitiruvchilarini afzal ko‘radilar, bu esa bitiruvchilarning muvaffaqiyatli ishga joylashish va ko‘tarilish imkoniyatlarini oshiradi.

4. Xulosa

4-jadval

Toshkent davlat transport universitetida xalqaro reytinglariga kirishi bo‘yicha ishlarni amalga oshirish uchun DASTUR

T/r	Chora-tadbirlar nomi	Amalga oshirish mexanizmi
1	2	3
Tashkiliy chora-tadbirlar		
1.	Oliy ta’lim muassasalari tomonidan xalqaro reyting tashkilotlariga ma’lumotlar taqdim etish bo‘yicha uslubiy ko‘rsatmalar ishlab chiqish	1. Xalqaro reyting tashkilotlari hamda xorijiy oliy ta’lim muassasalarining ma’lumotlar taqdim qilish tajribasini o‘rganish.
2.	Xalqaro reytinglar bilan ishlash bo‘yicha mutaxassislarni tayyorlash	1. Universitet xodimlaridan xalqaro reytinglar bilan ishlash bo‘yicha mutaxassislar tanlab olish. 2. Xalqaro reytinglar bilan ishlash bo‘limi nizomini ishlab chiqish, universitet Kengashida tasdiqlash va bo‘limni tashkil qilish, maqsadli ko‘rstakichlarni joriy qilish.
Toshkent davlat transport universitetining THE xalqaro reytinglarga kirishi bo‘yicha faoliyatini tashkil qilish		
3.	Universitetda boshqaruv va o‘quv jarayonini raqamlashtirish	1. Universitetda boshqaruv va o‘quv jarayonini raqamlashtirish ishlarini amalga oshirish. 2. Rasmiy veb-sayt va ijtimoiy tarmoqlardagi rasmiy sahifalarda xorijiy tillarda kiritiladigan ma’lumotlar ulushini oshirib borish.

4.	Xorijiy oliy ta’lim muassasalari dasturlari asosida o‘qitishni tashkil qilish	1. Universitet tomonidan xalqaro reytinglarda dastlabki 300 talik ro‘yxatda bo‘lgan xorijiy oliy ta’lim muassasalari dasturlarini o‘rganish va tahlil qilish. 2. Tahlil asosida o‘qitish tashkil qilinadigan fanlar (modullar) ro‘yxatini shakllantirish va joriy qilish
5.	Professor-o‘qituvchilar va talabalarning xorijiy tillarni bilish darajasini oshirish	1. Professor-o‘qituvchilar va talabalarning xorijiy tillarni bilish darajasini oshirish bo‘yicha ko‘rsatkichlarni ishlab chiqish va amalga oshirish.
6.	Xorijiy oliy ta’lim muassasalarida ta’lim olgan professor-o‘qituvchilar sonini oshirish	1. Xorijiy oliy ta’lim muassasalarida ta’lim olgan O‘zbekiston fuqarolarini aniqlash, ular bilan muzokaralar olib borish va ishga qabul qilish. 2. Talabalarni maqsadli ravishda tayyorlash va magistratura bosqichini yetakchi xorijiy oliy ta’lim muassasalarida o‘qib kelishi uchun yuborish va o‘qib kelganidan keyin ishga olib qolish bo‘yicha chora-tadbirlarni amalga oshirish.
7.	Universitetdagi jalb qilingan xorijiy professor-o‘qituvchilar ulushini oshirish	1. Universitet tomonidan xorijiy tillarda o‘qitiladigan fanlar ulushini ko‘paytirib borish choralarini ko‘rish. 2. Xorijiy professor-o‘qituvchilar bilan muzokaralar olib borish va ularni ishga qabul qilish.
8.	Xorijda malaka oshirgan professor-o‘qituvchilar ulushini oshirish	1. Xorijiy oliy ta’lim va ilmiy tashkilotlarda professor-o‘qituvchilar malakasini oshirish bo‘yicha chora-tadbirlarni belgilash.

Toshkent davlat transport universiteti faoliyatini strategik rejalashtirishning asosiy yondashuvlarini o‘rganib chiqqan holda universitet faoliyati uchun juda muhim hisoblangan quyidagi asosiy bosqichlardan tashkil topishini tahlil qilib chiqdik: Universitetning joriy holat tahlili bosqichi, universitetning missiya va maqsadlarni aniqlash bosqichi, universitetning SWOT tahlili o‘tkazish bosqichi, universitetning uzoq muddatga mo‘ljallagan strategiyani ishlab chiqish bosqichi, maqsadlarga erishish uchun zarur harakatlar va tadbirlarni ishlab chiqish bosqichi, strategiyaning amalga oshirilishini monitoring qilish va baholash bosqichi. Mana shu 6 ta bosqichni umumiy tahlil qilib har bir bosqichning o‘z xususiyatlarini tahlil qilib universitetni strategik rejalashtirish modeli tuzib chiqildi.

Universitetni strategik rejalashtirish modeli asosiy 2 ta qisim ta’lim va ilmdan tashkil topgan bu 2 muhim jihatni rivojlantirish uchun qo‘shimcha bir nechta strategik rejaning bo‘g‘inlari tanlab olindi. O‘quv jarayoni, ilmiy-tadqiqot jarayoni va tarbiya jarayoni ham strategik rejalashtirish modelimizning muhim jihati sifatida ko‘rib o‘tilgan.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Uktamov Sarvar Atxam o‘g‘li	Toshkent davlat transport universiteti magstranti. e-mail: uktamovsa@gmail.com tel:+998998746575 https://orcid.org/0009-0006-0298-9475
Pulatova Gulchexra Erkinovna	TDTU “Korporativ boshqaruv” kafedrasi mustaqil izlanuvchisi. e-mail: pulatovag873@gmail.com tel: +99893-536-16-32 https://orcid.org/0009-0006-6358-624X

Talipova Gulnoza Davron qizi
Toshkent transport texnikumi email: guli_bokhodirova@mail.ru tel.: +998977089944
ORCID: https://orcid.org/0009-0001-1567-1822

Checking traffic safety requirements for transportation of oversized cargo in railway transport (on 1520 mm railroad tracks)

I.M. Toshtemirov[1], R.Sh. Bozorov[1][a], D.Sh. Boboev[1][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: The main purpose of the work is to determine and check the levels of undersize of large loads loaded into open traffic. In this article, the analysis of safety conditions in the transportation of goods through undercarriage was carried out. In the study, the possibilities of organization of transportation were considered due to the analysis of the levels of underweight, depending on the geometric dimensions of the transported cargo. In this, the limits of the dimensions of compliance with the gauge levels of large-sized cargo are given, and the calculation of safety requirements for types of cargo outside these limits is performed. Also, based on the research of the operation sequence of the modern type of control frame, the possibility of more accurate and quick determination of the safety of the traffic was considered.

Keywords: Oversized loads, control frame, safety requirements, levels of oversize, movement composition, safety distance, inspection.

1. Introduction

The degree of unevenness of the rolling stock should be taken into account in the straight and curved parts of the railway. If the dimensions of the wagon together with the load exceed the limits specified in the curves, then the loaded wagon cannot pass through these curves. Calculated underweight is determined for oversize loads when the ratio of the length of the load to the length of the rolling stock exceeds 1.41.

Depending on the height of the loaded open rolling stock from the level of the rail head, three main unevenness zones are defined:

- Lower: 480 -1399 mm;
- Side: 1400 - 4000 mm;
- High: 4001 - 5300 mm.

These disparity zones, in turn, are divided into levels depending on the size deviation:

- In the lower minor zone: six degrees;
- In the zone of lateral inferiority: six degrees;
- In the zone of high inferiority: three levels.

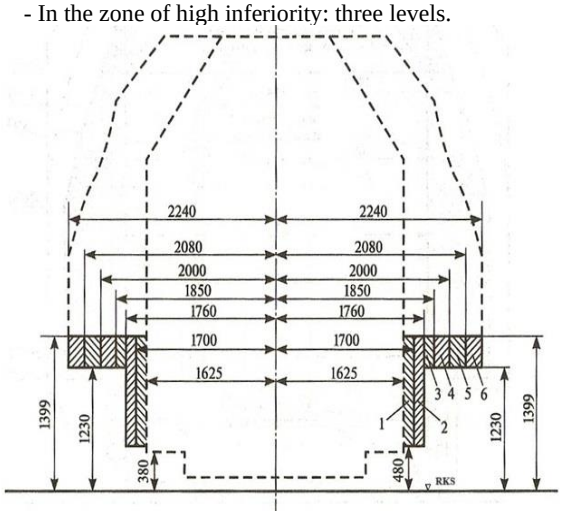

Figure 1. Distribution of degrees of inferiority

The category of oversize cargo includes cargo that horizontally protrudes from the contour of the zones and is higher than 5300 mm above the level of the railway rail head. If the height of the load is more than 5300 mm, then it is called extremely high underweight.

In railway transport, there is an underweight index, and underweight zones and levels of cargo are indicated by five characters. Each symbol of the weight index has a separate meaning and represents the level of weight of the load in a certain zone. The number 8 is used to indicate the extremely high roughness in any zone.

Signs in the Immaturity Index:

Character 1: letter N (oversize);

Character 2: the lower degree of underdevelopment, from 1 to 6;

Character 3: degree of lateral insufficiency, from 1 to 6;

Character 4: high degree of underdevelopment, from 1 to 3;

5th sign: extremely immature, number 8.

If there is no level of inequality in the movement, the index symbol is marked with the number “0”. For example, the index N8380 indicates that the load has bottom and top misalignment, and does not have side misalignment of the 3rd degree.

2. Literature analysis and methodology

In order to calculate the underweight levels of cargo delivered for railway transport, shippers must submit loading schemes in three projections, respectively. The coordinates of the turning points are indicated by horizontal distances from the road axis (X) and vertical distances from the level of the rail head (Y), and the load is placed on the platform according to the following conditions:

- The lower support surface of the load must be at the level of the platform base.
- The vertical axis of the transverse contour passing through the center of gravity of the load is combined with

[a] https://orcid.org/0000-0001-8655-0764
[b] https://orcid.org/0000-0003-0785-2209

the vertical axis passing through the center of gravity of the platform.

The coordinates of the turning points of the loaded load are determined along the horizontal and vertical axes, taking into account its location on the platform. These conditions are important in determining the safety of cargo movement and determining the level of underweight.

$X_i=B_i$; $Y_i=h_p+h_i$, (1)

where, B_i - is the distance of the pivot point i (i=1.5), (i=1.5), passing through the center of gravity from its vertical axis along the width of the load, (mm);

h_p — the height of the wagon base from the level of the rail head (mm);

h_i — the height of the turning point of the load from the surface of the cross section (mm).

The calculated imbalance is determined separately for the internal and external parts at the turning points of the load. All parts located on the base of the rolling stock are considered internal parts of the cargo. External parts are parts located outside the base of the rolling stock.

If the ratio of the length of the load to the length of the rolling stock exceeds 1.41, or if the load is transported on combined platforms or on conveyors, it is considered undersized.

Correct calculation of the height of the lower supports is of particular importance in order to correctly place the base of the increased load on the combined platform. The height of the lower supports:

$$h_0 = a_p tg\gamma + h_p + h_x + f_{\text{пр}}, \quad (2)$$

where, a_p - is the distance from the edges of the open rolling stock or the load that can touch it to the axis of the wheel pair of the rolling stock, m:

$$a_p = 0.5(L_{load} - L_b - 1850) \quad (3)$$

where, L_{load}, L_b - is the length of the loading area of the load and moving structure, mm;

$Tg\gamma$ - the value of the tangent of the angle between the longitudinal axes of the load and the combined platform;

h_p – the difference between the levels of the combined platforms; $h_p \leq 100$ mm;

h_x - safety margin, mm;

f_{bur} - value of elastic deflection, mm.

Taking into account the height of the lower supports, the coordinates of the turning points of the load should be measured from the rail level, depending on the type of load placement scheme., Y_{his}:

$$Y_{his} = Y_i + h_p + h_i + h_0 \quad (4)$$

The coordinates of the critical points calculated from the road axis of the loaded wagon can be calculated according to the coordinate axes using the following expressions:

$$X_{his}^{ich} = X_{ich} + \Delta b_{his}^{tash}, \quad (5)$$

$$X_{his}^{tash} = X_{tash} + \Delta b_{his}^{tash}, \quad (6)$$

where, X_{his}^{ich}, X_{his}^{tash} - the distances from the loading axis of the rolling stock to the critical points, located in the inner and outer parts, respectively, are determined in millimeters;

X_{ich}, X_{tash} - the distance from the straight parts of the critical points located on the inner and outer parts, respectively, to the road axis is measured in millimeters;

Δb_{his}^{ich}, Δb_{his}^{tash} - values that take into account the differences in the geometric views of the internal and external parts of the cargo and the conditional calculated curvatures of the traffic structure.

These values depend on the type of rolling stock, the distance, and the following tables or calculation methods can be used to determine them.

When using these values, it is calculated for cases not listed in the tables. If the size of the load does not change in the plane of the platform, then it will be enough to check the coordinates only on the inner and outer parts, which are considered the most dangerous areas.

The values used when loading oversized cargo onto a combined platform or vehicles with a number of axles not exceeding six are taken into account with their permissible value:

$$\Delta b_{his}^{ich} = 1.43(l_b - p_{ich})p_{ich} - 105, \quad (7)$$

$$\Delta b_{his}^{tash} = 1.43(l_b - p_{ich})p_{tash} - 105 + K, \quad (8)$$

where, p_{ich}, p_{tash} – the inner and outer values can be found by calculating as follows:

$$p_{ich} = 0,5\ l \quad (9)$$

$$p_{tash} = 0,5\ (L_{yuk} - l_b) \quad (10)$$

105 – the exit of the platform at the standard radius of curvature, mm;

K - additional displacement of the load during movement, mm.

The rate of additional displacement is determined depending on the type of vehicle:

In specialized platform types:

$$K = 70(\frac{L_{yuk}}{l_b} - 1.41); \quad (11)$$

In normal platform types:

$$K = 55(\frac{L_{yuk}}{l_b} - 1.41); \quad (12)$$

2. Results and discussion

After receiving the necessary information on finding the load imbalance levels and the values needed to determine it, checking these expressions through specific examples is important to gain a more accurate understanding of the load imbalance levels. To make these calculations, an analysis of the position of the load base with a length of 21.72 m on a platform with a length of 9.72 m was carried out. In this case, since the width of the load at the height of the oversize limit of 1400-3850 mm is 3600 mm, this load corresponds to the 2nd level of side undersize. It is enough to determine the internal and external disparity distances, taking into account that the shape of the load is unchanged in terms of width, height and length. These calculations can be calculated using expressions (9) and (10):

p_{ich}=0,5 l = 0,5·9,72 = 4,86 m;

p_{tash}=0,5 (L - l) = 0.5 (21.72 - 9.72) = 6 m;

Differences in geometric deviation can be determined from the technical conditions of loading and fastening.

$\Delta b_{his}^{ich} = f_{ich}$ va $\Delta b_{his}^{tash} = f_{tash}$

According to the technical conditions l = 9,72 and p_{int} = 4,86 m from being f_{int} = 0.

According to the technical conditions l = 9,72 and p_{exte}= 6 m from being f_{exte} = 88 mm.

Through these calculations, expressions (5) and (6) are used and the dimensions of the discrepancy are calculated:

$X_{ich} = X + f_{ich} = 1800 + 0 = 1800$ mm;

$X_{tash} = X + f_{tash} = 1800 + 88 = 1888$ mm;

X_{cal}^{exte} - by comparing the value of 1888 mm with the specified dimensions of oversize, conclusions are drawn that this load corresponds to the 4th level of oversize.

A 16-axle conveyor with a length of 25.17 m and a base

of 21.72 m is loaded with a load with a length of 43.25 m, a diameter of 3 m, and a base of 6.03 m. In this case, the load is 1500 mm wide from the road axis and 3600-4500 mm above the level of the rail head at a value of 1230 mm. In this case, the load is considered not to have left the gauge lines.

To determine the oversize, it is necessary to calculate the outermost parts of the load. Since the dimensions of the load do not change, the inner and outer values for the outermost parts are determined by expressions (9) and (10).

$P_{int} = 0,5\ l = 0,5 \cdot 25,17 = 12,585$ m;

$P_{exte} = 0,5\ (L - l) = 0,5\ (43,25 - 25,17) = 9,040$ m.

For levels of underweight: for internal parts of cargo - according to formula (5); for external parts – according to formula (2):

The difference in geometric outputs Δb_{cal}^{int} and Δb_{cal}^{exte}

$\Delta b_{cal}^{int} = f_{int} + f_0$, $\Delta b_{cal}^{exte} = f_{exte} - f_0$

These values are found using specifications:

F_{int} is taken from "Technical conditions for placement and securing of loads", since rolling stock with a base length of 25.17 m is not in the technical conditions, between the values of l = 25 m and l_2= 26 m, f_{int} = 12.585 m ≈ 12.6 m is calculated by determining interpolation: $f_1(l_1$ = 25 m) is 118 mm, f_2 (l_2 = 26 m) is equal to 135 mm.

f_{int}= 118 +(135-118) · (25,17 -25) =118+3=121 mm.

f_{exte} it is also necessary to determine the interpolation from the technical conditions.

l_1 = 25 m and p_{exte} = 9,04 m = 9 m, f_1 = 356 mm;

l_1 = 26 m va p_{exte} = 9,04 m = 9 m, f_2 = 367 mm;

bunda f_{exte}= 356 + (367 - 356) · (25,17 - 25) = 358mm.

The following accounts are determined in the same sequence:

X_{cal}^{int} = 121 + 13 = 134 mm;

X_{cal}^{exte} = 358 - 13 = 345 mm.

Therefore, the values of the degree of inequality will be equal to:

Values at a height of 3600 mm:

X_{cal}^{int}= 1500 + 134= 1634 mm;

X_{cal}^{exte}= 1500 + 345 = 1845 mm;

Values at a height of 4500 mm:

X_{cal}^{int}= 1230 + 134 = 1364 mm;

X_{cal}^{exte}= 1230 + 345 = 1575 mm.

X_{cal}^{int} va X_{cal}^{exte} - comparing the results with the corresponding values of the imbalance levels, it is determined that this load has a level 3 lateral and a level 2 upper imbalance.

The loaded rolling stock has the following oversized dimensions: 1400 - 4050 mm in height and 1650 mm in width; 4050-4250 mm high and 1750 mm wide. The deviations of load sizes on curves are smaller than the deviations of open traffic. If this situation is observed, the requirements of undersize should be determined.

When determining the degree of oversize, according to the technical conditions, it can be determined that 4250 mm in height and 1750 mm half-width is the 3rd level of undersize. To determine the lateral dimension, the largest transverse dimension is taken at a height of 1400-4000 mm and more than 4000 mm. It can be calculated that the largest size is 1750 mm with a height of 4250 mm.

According to the technical conditions, it was determined that the rolling stock has 2nd level of lateral imbalance due to falling into the zone of lateral and upper imbalance. These degrees of disparity can be more clearly understood from Figure 2. The load added to the open traffic structure through the above calculations has the characteristics of 2nd degree lateral and 3rd degree upper imbalance. Irregularity is defined as N023.

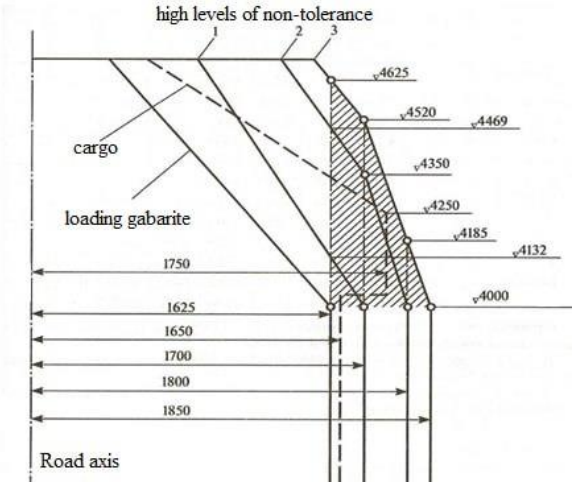

Figure 2. The scheme for determining the degree of lateral imbalance of the load added to the open traffic structure in the upper and side zones

Table 1

Determining levels of inadequacy

Nogabarity levels	Rank number	X and Y are the coordinates of the points, mm							
		1		2		3		4	
		X	*Y*	*X*	*Y*	*X*	*Y*	*X*	*Y*
bottom	1	1700	380	1700					
	2	1760	380	1760					
	3	1850	1230	1850	1399				
	4	2000	1230	2000					
	5	2080	1230	2080					
	6	2240	1230	2240					
Yeon	1	1700		1700	4000				
	2	1760		1760	4000				
	3	1850	1400	1850	4000				
	4	2000		2000	3700	1850	4000		
	5	2080		2080	3400	2000	3700		
	6	2240		2240	2800	2080	3400		
High	1	1700		1415	4500	880	5300		
	2	1800	4001	1700	4350	1480	4700	1020	5300
	3	1850		1700	4500	1120	5300		

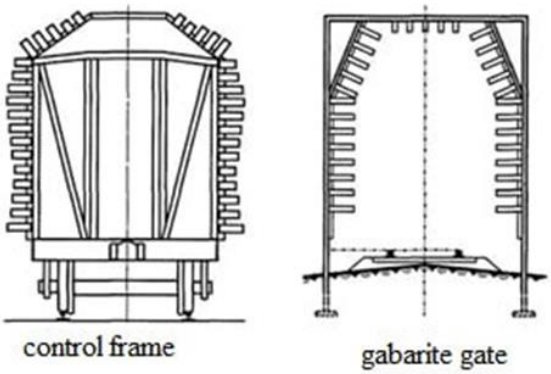

Figure 3. View of the control frame for oversized loads

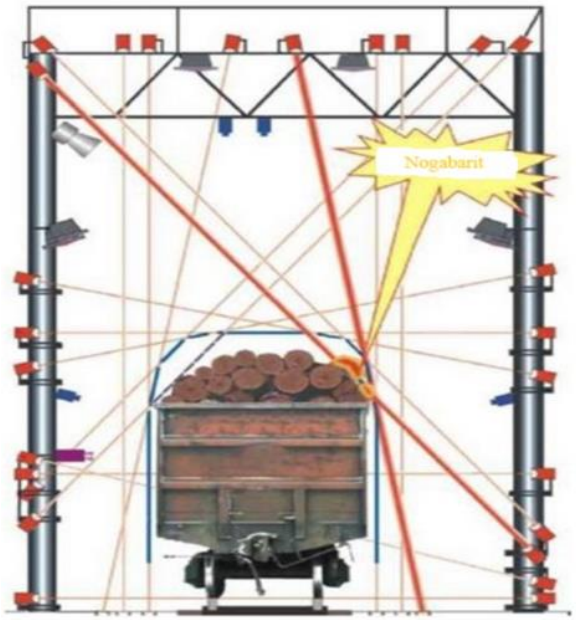

Figure 4. A control frame of modern type

Determining the levels of inadequacy is determined using Table 1 as follows:

1) indicates that the coordinates belong to the 3rd degree of lateral misalignment when X_{cal} = 1850 mm, Y_{cal} = 4000 mm.

2) indicates that the coordinates belong to the 4th degree of lateral misalignment when X_{cal} = 2000 mm, Y_{cal} = 3700 mm.

3) indicates that the coordinates belong to the 5th degree of lateral misalignment when X_{cal} = 2080 mm, Y_{cal} = 3400 mm.

It is passed through the control frame to check the degree of imbalance of the load added to the open movement (Fig. 3). The control frame consists of the main and additional contours.

In addition, there is also a modern control frame. Lasers, surveillance cameras, and sensor-notifiers that detect abnormality are installed in such a control frame (Fig. 4).

In such a system, whether or not the cargo complies with the measurement limits is checked using infrared sensors. Sensors mounted on the frame are placed so that infrared rays fall on the border of the gauge zone. When the infrared light falls on the part of the cargo floor, which is out of bounds, an alarm is sounded and the level of imbalance is displayed. Installation and replacement of control frames is entrusted to road distance workers.

The employee of the railway transport, who monitors the passage of the open rolling stock and the load loaded on it through the control frame, must control the passage of the loaded stock through the curved and straight parts of the track.

In the presence of such loads, the locomotive crew of the train must strictly follow the instructions of the railway transport officer, who monitors the passage of the control frame, in addition to the warnings specified in the documents. In the dark of the day and during the evening movement, the control frame should be illuminated with locomotive lighting. Regardless of the size of the cargo transported with the help of conveyors, these trains must be carried out according to the dispatcher's schedule.

3. Conclusion

In this work, analyzes and calculations on the transportation of large-sized cargoes are carried out, and additional suggestions are made for the determination and verification of the transportation procedure, gauge levels. In the article, the general requirements for acceptance of oversized cargo were considered, such things as oversized and oversized cargo in the wagon, determining the zone and level of oversized cargo, general requirements for transporting oversized cargo were studied. The 21.72 m long load under investigation is loaded on a platform with a base length of 9.72 m. It was determined that the level of the cargo with a width of 3600 mm in the part with a height of 1400 - 3850 mm corresponds to the 2nd level of lateral imbalance. In addition, the modern type of control frame was analyzed, its structure, operation procedure and possibilities were studied. In the future, providing railway stations with this type of control gates will further increase traffic safety and reduce the time spent on checking the compliance of cargo loaded into open traffic conditions.

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Information about the authors

Toshtemirov Inomjon Muqimjonovich Toshtemirov Inomjon Muqimjonovich	Doctoral student of Tashkent State Transport University, E-mail: Inomjon160382@gmail.com Phone number: +998994320316
Bozorov Ramazon Shamil o‘g‘li Bozorov Ramazon Shamil o‘g‘li	Senior lecturer of the Department of “Cargo transport systems” of the Tashkent State Transport University, (PhD). E-mail: ramazon-bozorov@mail.ru Phone number: +99891 2513377 https://orcid.org/0000-0001-8655-0764
Boboyev Diyor Shomurotovich Boboyev Diyor Shomurotovich	Senior lecturer of the Department of “Cargo transport systems” of the Tashkent State Transport University, (PhD). E-mail: diyor1803boboyev@gmail.com Phone number: +99890 4141803 https://orcid.org/0000-0003-0785-2209

The role of ai in enhancing omni-channel customer support system: a study of call centers in Uzbekistan

R.A. Abduqayumova[1][a], S.A. Uktamov[2][b]
[1]Westminster International University in Tashkent, Tashkent, Uzbekistan
[2]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: The swift adoption of Artificial Intelligence (AI) technologies is transforming call centre operations management, revolutionizing customer service and operational efficiency. This paper explores the impact of AI-driven tools, such as Speech-to-Text (STT) and Text-to-Speech (TTS) systems, on call centre performance and economic outcomes, focusing on the rapidly growing market in Uzbekistan. Drawing on qualitative interviews and quantitative market data, this research highlights how AI improves operational efficiency through customer conversation analysis, error tracking, and sentiment analysis. Additionally, the study provides a statistical forecast on market capture, showing potential growth trends for AI-based startups in Uzbekistan's telecommunications, EdTech, retail, and other key sectors. With a Serviceable Obtainable Market (SOM) of 1% and a n optimistic growth outlook, this paper argues that AI tools offer considerable strategic value for businesses aiming to enhance customer satisfaction and optimize service operations.

Keywords: Speech to Text, Text to Speech, AI, Market capture, call centers

1. Introduction

The customer service operations in many sectors are changing due to the swift advancement of Artificial Intelligence (AI) technologies. Call center operations management is one of the main areas where artificial intelligence (AI) is having a big impact[1]. Here, AI is being used more and more to analyze customer conversations, expedite workflows, and improve decision-making[2]. Artificial intelligence (AI)-driven technologies, like machine learning (ML) and natural language processing (NLP), are enabling managers access to real-time data-driven insights that improve customer satisfaction, cut costs, and increase operational efficiency[3][4].

Even though AI is being used more and more in this industry, little is known about how AI-driven insights may strategically improve operations management in contact centers[5]. This paper is aiming to highlight operational enhancement in sector segments that AI powered tools can bring.

Moreover, The STT (Speech to text) and TTS (Text to speech) technologies are widely being used by a range of industries including healthcare, IT & telecommunications, BFSI, automotive, government & legal, education, retail & ecommerce, media & entertainment, and others[6]. The world market size is calculated to be equal to USD 12.6B for STT and USD 2.8B for TTS in 2023 (Fortune Business Insights, 2023).

However, Uzbekistan as being one of the countries where busiensses are adopting STT and TTS AI tools very rapidly, quite limited research is avalible on economic value of current markets in Uzbekistans economy.

This reserch is aiming to develop statistic forecasts on market capture for coming years, based on market size, linear regressions trend analysis and market capture power of existing AI based startups.

2. Methodology and Data

The study utilized both quantitative and qualitative data to ensure comprehensive analysis. Primary data was collected through qualitative survey and interview of startup team members that are developing AI powered STT and TTS solutions for Businesses in Uzbekistan, offering firsthand insights into the research subject. In contrast, secondary data was obtained from State Statistics Committee of the Republic of Uzbekistan. Fortune Business Insight, peer-reviewed journals, and industry publications, ensuring that existing research and contextual data were incorporated into the analysis. While the primary data will focus on Uzbekistan market and economy, the benchmarking has been done based on international developed economies.

3. Results

The primary qualitative interview had contributed to reveal following operational advancements of AI tools in Context of Uzbekistan Market:

1. **Speech-to-Text (STT) Capabilities:**
   - **Languages Supported:** The STT technology supports multiple languages, including **Uzbek, Russian, Kazakh, and English**. This diversity allows for broad applicability in multilingual regions, especially in Central Asia.
   - **Speaker Identification:** AI tool can determine the **language spoken** and **identify individual speakers**, enhancing its utility in call centers where conversations may involve multiple agents or languages.
   - **Timestamps:** Each word recognized by the system is tagged with a **timestamp**, which can be critical for reviewing and analyzing specific parts

[a] https://orcid.org/0009-0002-9096-8666
[b] https://orcid.org/0009-0006-0298-9475

of conversations, ensuring efficient audit and compliance processes.

- **Performance and Accuracy:** 95% Recognition Accuracy
- **Deep Audio Wave Analysis:** This suggests that the system doesn't just transcribe basic audio but performs an in-depth analysis of the audio wave, possibly detecting nuances in tone, emotion, or speaker intent.
- **Specialization for Uzbek Language and Dialects**

2. **TTS Technology Overview:**

- **High-Speed Audio Analysis:** The technology analyzes audio "within fractions of a second," ensuring rapid and accurate recognition of speech, including its **stylistic diversity**. This allows for smooth, real-time interactions through voice assistants, eliminating delays in communication.
- **AI-Driven Text-to-Speech Conversion:** The system uses AI to **convert written text into natural-sounding speech**, enabling automated, human-like conversations. This is particularly valuable in automating customer interactions in call centers or virtual assistants.
- **Intonation Control:** The TTS system offers the ability to select different intonations, allowing customization of the speech tone to match the desired emotional context (e.g., polite, formal, or friendly).
- **Voice Selection**: Users can choose from a variety of voice options to fit different business needs, such as gender, age, or style, making interactions feel more personalized and engaging.
- **Automation for Call Centers**: The system enables automation of call center operations, where pre-programmed responses are voiced by the TTS engine, allowing agents to handle routine inquiries more efficiently or even replace them in certain cases with virtual agents.

3. **Analysis capabilities:**

- **Summary Analysis:** AI tools provide a **brief and accurate summary** of conversations or call interactions, which is extremely useful in call center environments for quickly reviewing key points discussed without going through the entire conversation.
- **Sentiment Analysis:** The system can analyze the **emotional tone** of the conversation (positive, negative, neutral) through sentiment analysis. This feature can be valuable in understanding customer satisfaction, agent performance, and the general mood of the interaction.
  Sentiment analysis helps in categorizing interactions for further action, like flagging dissatisfied customers or providing follow-up service.
- **Translation:** The inclusion of **translation capabilities** indicates that AI system can process and convert speech or text between multiple languages, which is ideal for multilingual call centers operating globally. This functionality ensures that customer inquiries are understood and addressed, regardless of the language spoken.

When it comes to quantitative analysis the research has been conducted in two aspects:
Key Features of Speech analytics across sectors and economic market capture forecast.

1. **Feature analysis by Sector**

In the economic context of Uzbekistan, the main niche market that AI startups are concentrating on are following: Telecommunications, EdTech, Retail, Auto service, fitness, real estate, healthcare, financial institutions, taxi service. When the key features of AI tools have been analyzed by each sector the following table has been made:

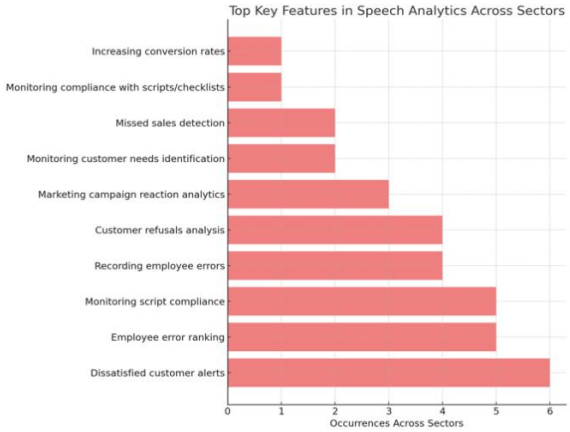

Figure 1: Top Key Features in Speech Analytics Across sectors

From Figure 1 it can be concluded that Dissatisfied customer Alert is one of the biggest problems that Speech analysis tools can solve. Ranking employees based on errors they make during customer interactions is a prevalent practice, which helps improve training and performance management. This feature is frequently used to track and analyse mistakes made by employees during interactions, providing valuable data for performance improvement. And especially for customer-oriented service sector customer refusal analysis, need identification, missed sales detection features is considered to be quite beneficial.

Speech analytics is a technology that allows firms to examine client interactions and derive insightful information. By immediately identifying unsatisfied customers in real-time, it enables businesses to promptly address the issue and enhance customer satisfaction. It raises operational efficiency and upgrades training programs by tracking employee performance through error ranking and script compliance monitoring. Speech analytics additionally helps in sales optimisation by detecting lost sales chances and examining customer refusals, which facilitates the improvement of marketing and customer service tactics. All things considered, it is a vital instrument for raising business outcomes, operational performance, and customer service in of industries.

2. **Economic market capture**

The world market size of STT and TTS is calculated to be equal to USD 12.6B and USD 2.8B in 2023 consequently, based on Fortune Business Insights. In this research the main concentration of STT and TTS based companies concentrated market sizes has been calculated based on statistics of State Statistics Committee of the Republic of

Uzbekistan.

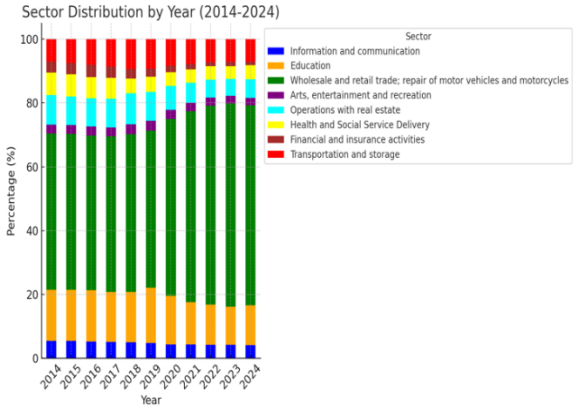

Figure 2: Sector Distribution by Year

Based on given statistics the linear graph of trend for each industry has been created as shown in Figure 3, indicating the increase trendline in the sectors that AI based startups concentrate on.

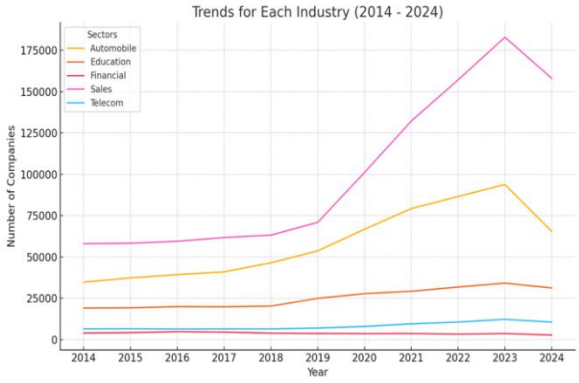

Figure 3: Trends by industry

When the market capture power of AI based startups has been calculated with SAM being equal to 10% and SOM being equal to 1% linear and accelerated growth for 10 years has been plotted in figure 4. If the industry sectors will have steady growth, and AI startups will have stable linear market capture power, the industry may still lie behind the world economic trend, but with Accelerated growth, AI startups has power to capture the considerable share of market within 10 years.

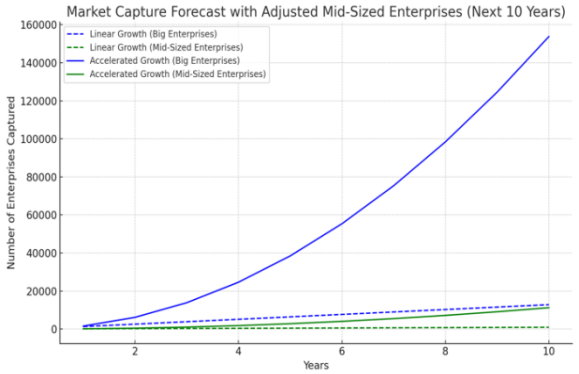

Figure 4: Market capture forecast

4. Conclusion

This study has successfully highlighted the profound impact of Artificial Intelligence (AI)-driven Speech-to-Text (STT) and Text-to-Speech (TTS) technologies on customer service operations within Uzbekistan's diverse economic landscape. Through a combination of qualitative insights from industry stakeholders and quantitative analysis of market data, the research underscores how these AI tools are revolutionizing call center management by enhancing operational efficiency, improving customer satisfaction, and enabling data-driven decision-making[7].

The qualitative findings reveal that advanced features such as multilingual support, high recognition accuracy, speaker identification, and sentiment analysis are pivotal in tailoring AI solutions to the specific needs of Uzbekistan's market. These capabilities not only streamline workflows but also provide nuanced insights into customer interactions, thereby facilitating more effective training, performance management, and personalized customer service. The ability of AI tools to perform deep audio wave analysis and offer customizable TTS options further enhances their applicability across various sectors, including telecommunications, healthcare, retail, and financial services[4].

On the quantitative front, the market analysis indicates a robust growth trajectory for AI-based startups in Uzbekistan. With the global market sizes for STT and TTS technologies projected at USD 12.6 billion and USD 2.8 billion respectively in 2023, the local market is poised for significant expansion. The forecast models, based on linear regression and market capture power of existing startups, suggest that Uzbekistan's AI sector could achieve substantial market penetration over the next decade, particularly under accelerated growth scenarios. This presents a lucrative opportunity for startups to capture a meaningful share of the market, driving economic value and fostering innovation within the region.

Moreover, the sector-specific feature analysis demonstrates that AI-driven speech analytics can address critical operational challenges such as identifying dissatisfied customers, optimizing sales processes, and enhancing employee performance. By providing real-time insights and actionable data, these technologies empower businesses to make informed decisions, thereby elevating overall service quality and operational performance.

However, the study also acknowledges certain limitations, including the nascent stage of AI adoption in Uzbekistan and the need for more comprehensive data to refine market forecasts. Future research should focus on longitudinal studies to track the sustained impact of AI integration and explore potential barriers such as data privacy concerns, integration costs, and the need for workforce upskilling.

In conclusion, the integration of AI-powered STT and TTS technologies offers a transformative potential for Uzbekistan's customer service operations. By leveraging these advanced tools, businesses can achieve enhanced efficiency, greater customer satisfaction, and significant cost savings. The promising market forecasts underscore the economic viability of investing in AI-driven solutions, positioning Uzbekistan as a burgeoning hub for AI innovation in the region. As AI technologies continue to evolve, their strategic implementation will be crucial in shaping the future of contact center management and driving sustained economic growth in Uzbekistan.

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Information about the authors

Abduqayumova Ruxsoraxon Atxam qizi	PhD candidate at Westminster international university in Tashkent Email: ruxsoraxon.abduqayumova@wiut.uz Tel: +998997636871 ORCID: https://orcid.org/0009-0002-9096-8666
Uktamov Sarvar Atxam o'g'li	Toshkent davlat transport universiteti magstranti. e-mail: uktamovsa@gmail.com tel:+998998746575 ORCID: https://orcid.org/0009-0006-0298-9475

Improvement of the methods of reliable delivery of cargo flows in the international direction (in the example of the Termiz-Mazari-Sharif route) Systematic analysis of the literature

G.A. Samatov[1][a], I.A. Maxsumov[1][b], D.F. Yo‘ldoshev[1][c]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: This article examines the example of the Termiz-Mazari Sharif route in the international transport of goods by road, rail and sea transport, and is devoted to the analysis of the interests of the countries participating in the formation of the trans-Afghan corridor, as well as its development prospects. is counted.

Keywords: International cargo transportation, Analysis of the activity of the Termiz Mazari-Sharif route, literature review, criteria, methods, economic relations

Xalqaro yo‘nalishda yuk oqimlarini ishonchli muddatlarda yetkazib berish usullarni takomillashtirish (Termiz-Mozori-Sharif yo‘nalishi misolida) Adabiyotlar tizimli tahlili

Samatov G.A.[1][a], Maxsumov I.A.[1][b], Yo‘ldoshev D.F.[1][c]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Ushbu maqola yuklarni xalqaro tashishda avtomobil, temir yo‘l va dengiz transportlari orqali, transafg‘on koridorini shakiltirishda ishtirok etuvchi mamlakatlar manfaatlari Termiz-Mozori Sharif marshruti misolida ko‘rib chiqilgan bo‘lib uning rivojlantirish istiqbollari tahlil qilingan.

Kalit so‘zlar: xalqaro tashuvlar, Termiz Mozori-Sharif marshruti faoliyati tahlili, adabiyatlar tahlili, mezonlar, usullar, iqtisodiy munosabatlar

1. Kirish

So‘nggi yillarda Markaziy Osiyoni yagona mintaqa sifatida rivojlantirishning ahamiyati va dolzarbligini e’tiborga olgan holda, faol mintaqaviy siyosat yuritish, Markaziy Osiyoda qulay siyosiy muhit yaratish, mintaqadagi mamlakatlar bilan birga barcha yo‘nalishlarda, jumladan, O‘zbekiston tashqi siyosatining ustuvor tarmoqlaridan bo‘lgan transport sohasi bo‘yicha konstruktiv va o‘zaro manfaatli munosabatlarni yo‘lga qo‘yish masalalarida belgilab olingan vazifalar bo‘yicha salmoqli ishlar amalga oshirilmoqda. Transport sohasi bo‘yicha konstruktiv va o‘zaro manfaatli munosabatlarni yo‘lga qo‘yish masalalarida belgilab olingan vazifalarda halqaro yuklarni tashish tizimini takomillashtirishga alohida e’tibor qaratilmoqda. [3]

Xalqaro yuklarni tashish tushunchasiga turli sohalarning iyerarxik maqsad va vazifalarini inobatga olgan holda turlicha ta’riflar berilgan.

Umuman olganda avtomobillarda xalqaro tashishlarni rejalashtirishning aniqligini oshirish orqali - boshqaruv sifatini oshirish va buning natijasida avtomobillarda xalqaro tashishlar faoliyati samaradorligini mumkin. Ma’lumki, bojxona faoliyati bilan bog‘liq muammolar tufayli avtomobillarda xalqaro tashishlarlarni rejalashtirish va tashkil etish murakkab jarayonlarni qamrab oladi. Halqaro tashuvlarda yuklarni ishonchli muddatlarda (o‘z vaqtida), havfsiz va kamxarajat bilan yetib borishini ta’minlash, transport sohasi bo‘yicha konstruktiv va o‘zaro manfaatli munosabatlarni tashkil etishning ustuvor yo‘nalishlardan biri hisoblanadi.

Xalqaro yo‘nalishda yuk oqimlarini ishonchli muddatlarda yetkazib berish usullarni takomillashtirish maqsadida, bu borada ijobiy natijalarga erishgan va ilmiy yondoshuvlar asosida sohaga yangi usullarni joriy etish bo‘yicha tavsiyalar ishlab chiqgan olimlar izlanishlari tahlil qilindi.

2. Tadqiqot metodologiyasi

Xalqaro yo‘nalishda yuk oqimlarini ishonchli muddatlarda yetkazib berish usullarini takomillashtirish tadqiqot ishida adabiyotlar tahlilini o‘tkazish uchun tanlangan adabiyotlarni tizimli, miqdoriy va sifat jihatdan tavsiflashga qaratilgan usullardan foydalanildi. Ma’lum bir

[a] https://orcid.org/0000-0001-6479-6173
[b] https://orcid.org/0009-0002-7265-361X
[c] https://orcid.org/0000-0002-6042-2737

mavzu bo‘yicha adabiyotlar tahlilini o‘tkazish bu ushbu mavzu bo‘yicha qaralayotgan davrgacha amalga oshirilgan ilmiy ishlar va natijalar haqida malumotlarni umumlashtirishda juda muhim vosita sanaladi. Ushbu tahlilni amalga oshirishda quyidagi mezonlar e’tiborga olindi:

-adabiyotni ko‘rib chiqish savollarini tuzish;

-adabiyotlarni malum mezonlar asosida chegaralash;

-tadqiqotni amalga oshirish uchun adabiyotlarni qidirish bazalarini belgilab olish;

-adabiyotlarni tanlab olish;

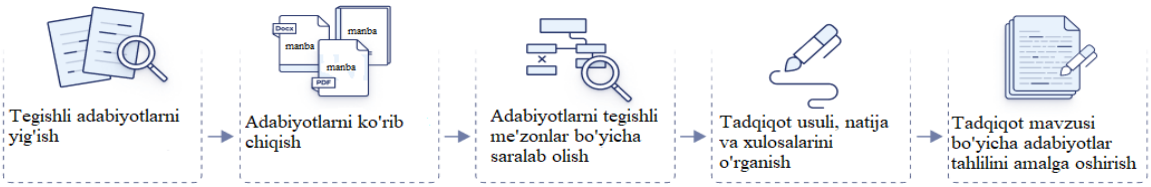
-adabiyotlarda mavzuning o‘rganilganlik darajasini baholash;

-tegishli malumotlarni ajratib olish;

-natijalarni tahlil qilish

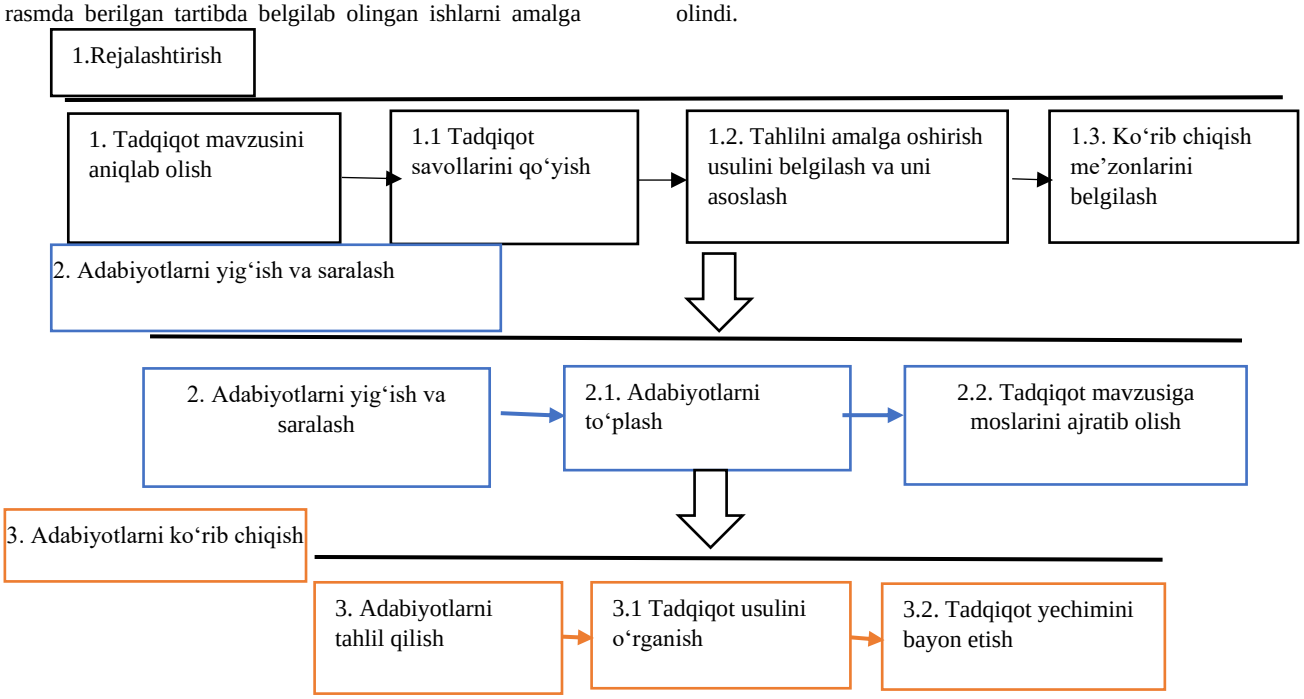
-natijalarni sharhlash va tadqiqot yechimini maqolada bayon etish [45].

Yuqorida sanab o‘tilgan mezonlarni etiborga olgan holda tadqiqot ishini amalga oshirishning dastlabki rejalashtirilgan usulini quyidagi 1-ramda ko‘rsatib o‘tilgan.



1-rasm. Adabiyotlar tahlilini amalga oshirish jarayonlarining ketma-ketligi

Tadqiqot ishi mavzusi bo‘yicha adabiyotlar tahlilini o‘tkazishda tizimlilik va ketma-ketlikni taminlash hamda 1-rasmda berilgan tartibda belgilab olingan ishlarni amalga oshirish maqsadida 2-rasmda tasvirlangan bosqichlar va yo‘nalishlar bo‘yicha ishlarni amalga oshirish belgilab olindi.



2-rasm. Adabiyotlar tahlilini amalga oshirish mezonlari asosida tadqiqot ishini bajarishning uch bosqichli sxemasi (mualif ishlanmasi)

3. Muhokama va natijalar

Adabiyotlar va turli ilmiy-tadqiqotlar natijalari yoritilgan nashrlarni tahlil etish asosida yuklarni yetkazishda sifat mezonlari sifatida quyidagilarni ko‘rsatish mumkin [8].

- ko‘rsatilayotgan transport xizmatining narx-navosi;
- yuk va yo‘lovchilarni yetkazib berish ishonchliligi;
- yuklarni yetkazib berish texnologiyasi va boshqarilishining turli tashish sharoitlari va iste’molchilar talablariga moslashuvchanligi;
- xizmat ko‘rsatishning har tomonlama to‘laligi va ehtiyojni qamrab olishi;
- axborotlashganligi;
- erishish (olish) osonligi (mushkul emasligi).

Bozor iqtisodiyoti sharoitida yuklarni yetkazib berish ishonchliligini ta’minlash muhim ahamiyat kasb etadi Tadqiqot ishini amalga oshirishda to‘plangan adabiyotlardan tadqiqot mavzusiga moslarini ajratib olish uchun PRISMA (Preferred Reporting Items of Systematic reviews and Meta-Analyses) Flow Diagram usuli tanlab olindi. Tadqiqot ishi mavzusini ko‘lami va chegaralarini aniqlab olish uchun u bo‘yicha amalga oshirilgan ishlarni ko‘rib chiqish va tahlil qilish judayam muhim sanaladi. Biror bir belgilab olingan mavzu bo‘yicha tadqiqot ishini amalga oshirishni boshlagan tadqiqotchilar albatta tadqiqot ishi mavzusi bo‘yicha adabiyotlar tahlilini o‘tkazadilar.

Adabiyotlar tahlilini amalga oshirishda ilmiylik va ishonchlilikni taminlash maqsadida bir guruh tadqiqotchi olimlar tamonidan xalqaro marshrutlarda yuk oqimlarini

aniq va o‘z muddatida yetkazib berishni rejalashtirishning analitik usullari tanlab olindi.

Xalqaro marshrutlarda yuk oqimlarini aniq va o‘z muddatida yetkazib berishni ta’minlash bo‘yicha ilmiy manbalarda xalqaro marshrutlarda yuk oqimlari tushunchasiga turli tariflar berilgan bo‘lib, quyida (2-jadval) mazkur tushunchaning turli variantdagi talqinlari keltirilgan: (V.A.Dolgov) [10]

Quyidagi .1-jadvalda yuklarni yetkazib berish sifatini baholovchi ko‘rsatkichlar, ularni aniqlanish usullari va axborot manbalari ko‘rsatilgan [8].

1-jadval

Yuklarni yetkazib berish sifatini baholovchi ko‘rsatkichlar

	Turli talqinlar							**Jami**
	Tizim	**Tamoyil**	**Yondashuv**	**Kontsepsiya**	**Usul**	**Strategiya**	**Model**	
1. RF manbalari	11	10	3	5	3	2	2	22
2. Chet el adabiyotlari	10	2	5	3	3	1	-	13
Jami talqinlar	21	12	8	8	6	3	2	35

Yuqorida (1-jadval) yuklarni yetkazib berish sifatini baholovchi ko‘rsatkichlar, ularni aniqlanish usullari va axborot manbalari ko‘rsatilgan bulib ularning turli talkinlari keltirilgan [8].

1-jadvaldan quyidagi xulosalarni chiqarish mumkinligi Sh.A. Bo‘tayev tomonidan berilgan:

• “aniq o‘z muddatida” tushunchasi adabiyotlarda bir xil talqin etilmagan;

• ko‘pchilik olim va mutaxassislar “aniq o‘z muddatida” tushunchasin kontseptual bayon ko‘rinishida yoki semantik darajada keltirganlar, faqat ikki manbada [26, 28] mazkur talab model darajasiga yetkazilgan. Ba’zi bir ilmiy ishlarda [28, 29] aniq o‘z muddatida yetkazib berishga oid modellar tavsiya etilgan. Ayrim yondashuvlarda [28] yetkazib berishning haqiqiy muddati bilan rejalashtirilgan muddati orasidagi farqdan kelib chiqadigan yo‘qotishlar narxini kamaytirish (minimallashtirish) masalasi qo‘yilgan bo‘lsa, boshqa ishlarda [29] yetkazib berish muddatining rejalashtirilgan qiymatini bajarish ehtimolini belgilangan darajada ta’minlash mezonini bajarish imkoniyatlari ko‘rib chiqilgan.

Ushbu tadqiqotni amalga oshirish uchun adabiyotlarni to‘plashda Science Direct, Scopus, Research Gate va IEYEE Xplore Digital Library ma’lumotlar bazalari va boshqa ochiq manbalardan foydalanildi. Ushbu ma’lumotlar bazalaridan adabiyotlarni qidirishda yahlit tadqiqot mavzusi bo‘yicha qidirilganda tegishli adabiyotlar chiqmaganligi hamda Ilmiy adabiyotlarda “yukni aniq o‘z muddatida yetkazishni rejalashtirish” tushunchasi integrallashgan logistikaning asosiy obyekti – logistik sikl parametriga nisbatan qo‘llaniladi. Turli manbalarda quyidagi operatsiyalar logistik siklning bosqichlari sifatida ko‘rsatiladi [26]:

• buyurtmani tayyorlash va uzatish (t_1);

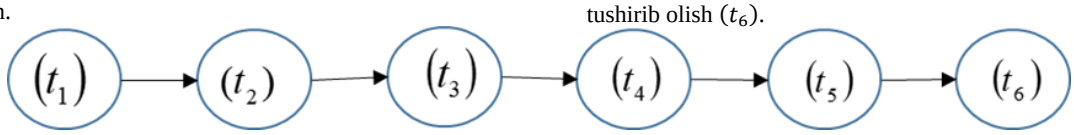
• buyurtmani olish va uni ishlash (t_2);

• buyurtmani komplektlashtirish va tayyorlash (t_3);

• buyurtmada ko‘rsatilgan yuk partiyasini transport vositalariga ortish (t_4);

• buyurtmani tashish, uni chegaralar, bojxonalar va terminallardan olib o‘tish (t_5);

• buyurtmani oxirgi terminaldan buyurtmachi tashkilotga yetkazib berish va transport vositalaridan tushirib olish (t_6).



3-rasm. Logistik siklning bosqichlari

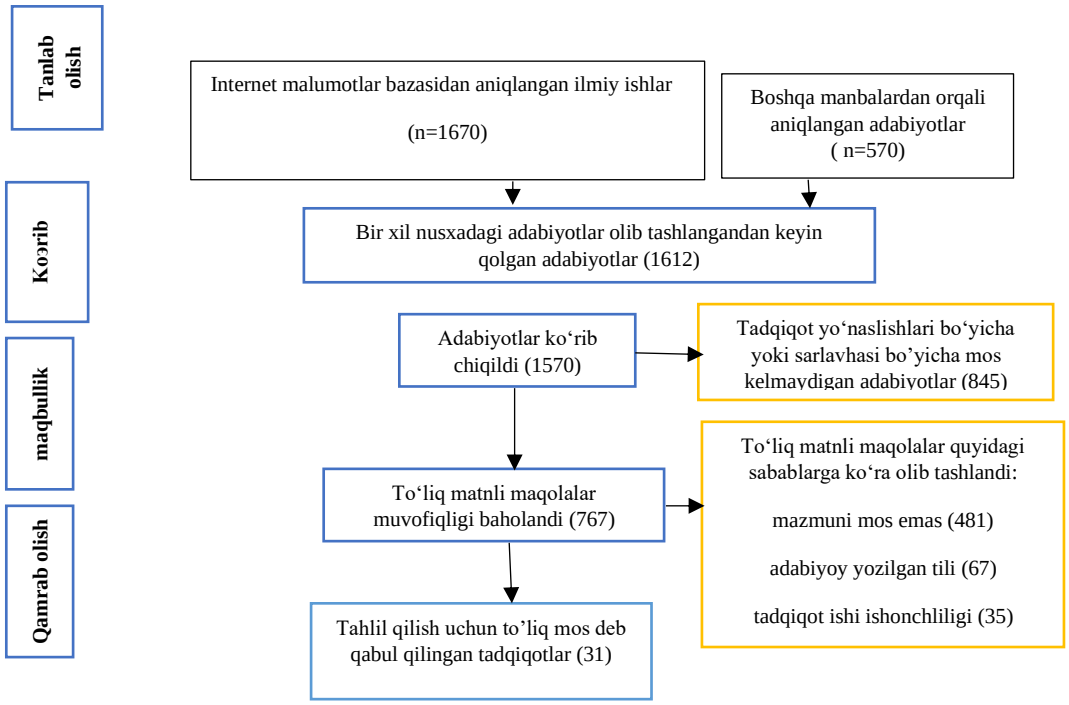
Logistik sikl va uning alohida bosqichlari bajarilish muddatlari turli olimlar tomonidan tahlil etilgan va ularning asarlarida keltirilgan: masalan, D.Dj. Bauersoks, D.Dj. Kloss, Dj. R. Stok, D.M. Lambert va M. Kristofer va boshqalar. Quyidagi 2-javdalda mazkur mualliflar asarlarida keltirilgan logistik siklning alohida bosqichlarini bajarishga sarflanadigan vaqt muddatlarini [26] manba ma’lumotlariga asoslanib keltiramiz. Mazkur jadvaldan ko‘rinib turibdiki, logistik siklning asosiy tarkib-bog‘lanishlari, tugunlari va shu kabilar moddiy – texnik ta’minot, ishlab chiqarish va ta’minlash jarayonlari uchun bir xildir. Logistik tizim qanday murakkab bo‘lishidan qat’iy nazar muhim bog‘lanishlarni aniqlash uchun alohida logistik siklning bosqichlari va konfiguratsiyasini tahlil etish kerak.

Logistik siklni tashkil etuvchi vaqt intervallari ma’lum taqsimlanish qonuniyati va parametrlariga ega bo‘lgan tasodifiy kattaliklarni yuzaga keltiradi.

Logistik siklning yuqorida bayon etilgan xususiyatlarini hisobga olgan holda “aniq o‘z muddatida yetqazish” modelini shakllantirish uchun birinchi navbatda quyidagi tahlillarni amalga oshirish lozim bo‘ladi [8]:

Yuqorida ko‘rsatilgan malumotlar bazalaridan foydalangan holda mualliflar birinchi bosqichda 1670 dan ortiq ilmiy adabiyotlarni to‘pladilar (Science Direct-103, Scopus-206, ResearchGate-406, IEEE Xplore Digital Library-314 va boshqalar-653).

To‘plangan adabiyotlar 1-jadvalda belgilab olingan mezonlar bo‘yicha va PRISMA Flow Diagram usuli yordamida tekshirilgandan keyin 1645 ta adabiyot chiqarib tashlandi va 31 ta adabiyot tahlil qilish uchun tanlab olindi. (4-rasmga qarang). [35]:



4-rasm. PRISMA Flow Diagram (PRISMA usuli asosida muoliflar tamonidan tuzulgan)

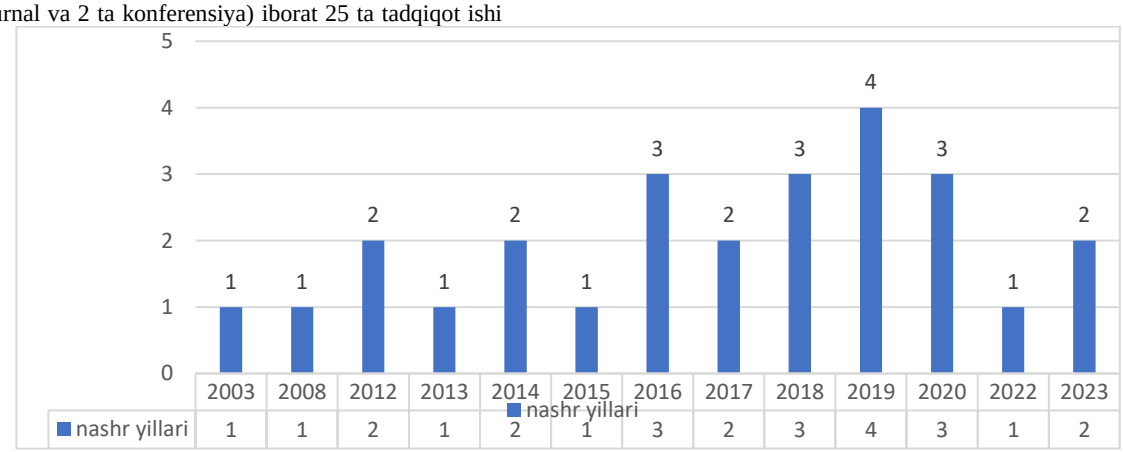
2-jadval

Tadqiqot ishida tahlil qilingan adabiyotlar

Adabiyot turi		**Soni**	**Ulushi**
Maqolalar	Ilmiy jurnal	15	60%
	Ilmiy konferensiya	2	8%
Dissertatsiyalar	Magistrlik	6	24%
	PhD	4	16%
	Doktorlik	4	16%
Umumiy		31	**100%**

Yuqorida takidlangan baholash mezonlari bo‘yicha tahlil qilish uchun tanlab olingan adabiyotlarni 2-jadvalda ko‘rsatilgan tartibda turlarga ajratib chiqdik.

Ushbu adabiyotlar tahlilida 6 ta magistrlik, 1 ta Phd 1 ta doktorlik dissertatsiyasi va 17 ta ilmiy maqolalardan (15 ta ilmiy jurnal va 2 ta konferensiya) iborat 25 ta tadqiqot ishi o‘rganildi. Tadqiqot ishida tahlil qilingan adabiyotlarning nashr yillari adabiyotlar tahlili amalga oshirilgan davrni belgilab olish va qaysi yillarda eng ko‘p adabiyot va eng kam adabiyotlar nashr qilinganligini anqilash maqsadida o‘rganib chiqildi va 5-rasmda tasvirlandi.



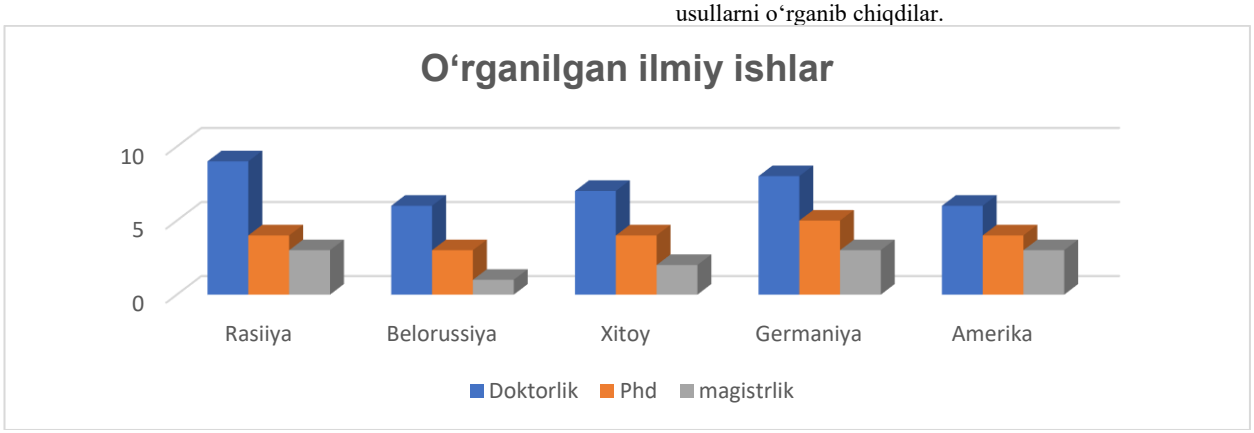
5-rasm. Tahlil qilingan adabiyotlarning nashr qilingan yillari

5-rasmdan malum bo‘ladiki tahlil qilish uchun tanlab olingan adabiyotlarningt eng ko‘p qismi ya’ni 16% 2019-yilga to‘g‘ri keladi va tadqiqot ishi 2003-2023 yillarni qamrab olgan. Shuningdek mualliflar adabiyotlar tahlilining ishonchliligini taminlash maqsadida tadqiqot ishida turli davlatlar tadqiqotchilari tomonidan amalga oshirilgan ishlarni ko‘rib chiqishni niyat qilganlar. Turli davlatlar ilmiy tadqiqotchilari tomonidan yozilgan ilmiy ishlarni o‘rganish

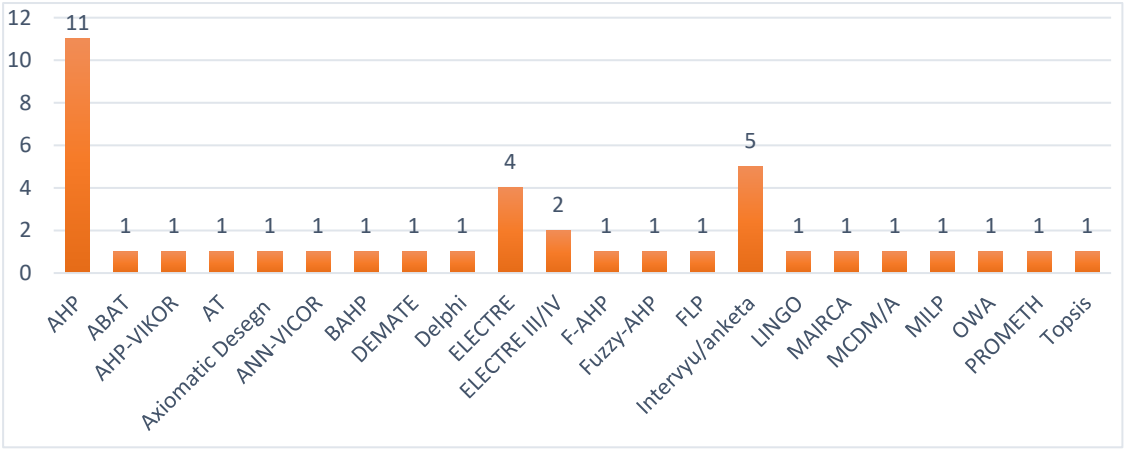
tadqiqot mavzusiga ko‘p tomonlama yondoshuvni ta’minlaydi. Quyida 5-rasmda tahlil qilingan adabiyotlarning davlatlar ulushi tasvirlangan. 5-rasmdan ko‘rinib turibdiki ushbu adabiyotlar tahlilini amalga oshirish jarayonida foydalanilgan adabiyotlar ichida dunyoning 12 ta davlati olimlari tamonidan Xalqaro tashuvlar bo‘yicha yuklarni ishonchli vaqtlarda yetkazib berishni ta’minlashga oid ilmiy ishlar o‘rganib chiqilgan, ularning eng ko‘p ulushi 37 % Rossiya va 35% Xitoylik olimlar ishlariga to‘g‘ri keladi.

Tadqiqot ishida muammoning bayon etilishi va uni yechishda qo‘llanilgan usullar erishilgan natijaning ishonchliligini ta’minlovchi jihatlar hisoblanadi.

Mualliflar tahlil qilingan adabiyotlarning tadqiqot muammosi Yuklarni xalqaro tashuvlarda vaqt masalasi bo‘lganligi sababli muammoni yechishda foydalanilgan usullarni o‘rganib chiqdilar.



5-rasm. Tahlil qilingan adabiyotlarning davlatlar bo‘yicha taqsimlanishi



6-rasm. Adabiyotlarda yuklarni xalqaro tashuvlarda muammosini yechishda qo‘llanilgan usullar

6-rasmda ko‘rsatilgan usullarning aksariyati ko‘p yoki bir mezonli qaror qabul qilish usullari oilasiga mansub bo‘lib, ular ichida eng ko‘p qo‘llanilish ko‘rsatgichi AHP (Analytic Hierarchy Process) analitik ierarxiya jarayoni 50% holatga to‘g‘ri kelgan. Mavzuni nazariy jihatdan tahlil qilishda intervyu/anketa usuli ommaviy tarzda eng ko‘p qo‘llanilar ekan. Yuqorida keltirilgan malumotlar asosida shuni aytishimiz mumkinki, tahlil qilish uchun tanlab olingan adabiyotlarning ishonchlilik darajasi mavzuni yoritib berishda barcha sifat mezonlariga to‘g‘ri keladi.

Adabiyotlar va turli ilmiy-tadqiqotlar natijalari yoritilgan nashrlarni tahlil etish asosida yuk va yo‘lovchilarni yetkazish sifat mezonlari sifatida quyidagilarni ko‘rsatish mumkin [8].;

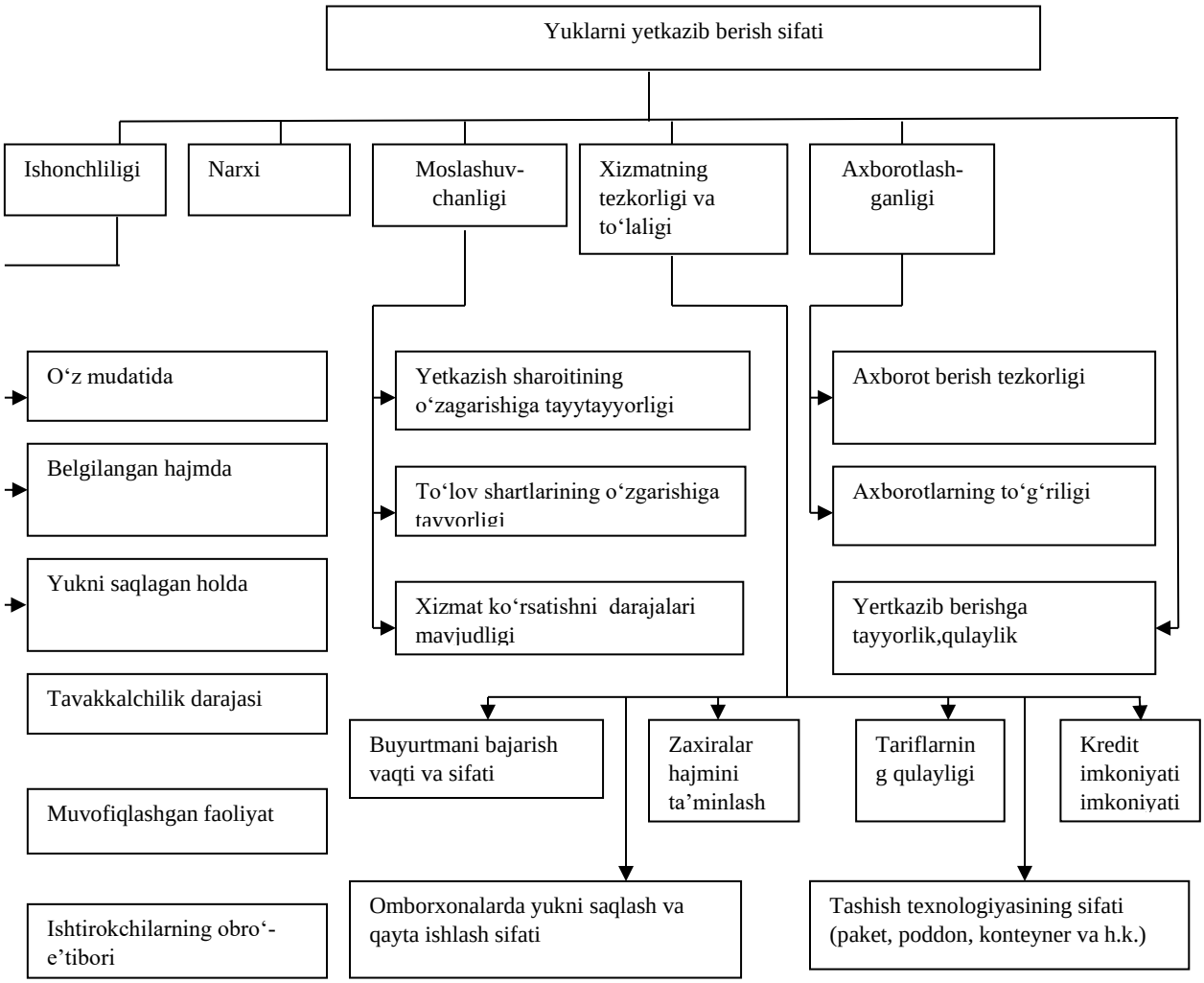
2-yondashuv. Aniq tegishli mezon va parametrlar asosida muayyan hudud uchun XAT masalasini ko‘p mezonli qaror qabul qilish usullaridan foydalanib yoki matematik model hisoblashlar yordamida aniqlash.

Ushbu ilmiy tadqiqot ishida tahlil qilingan adabiyotlarning 7 tasi 1-yondashuv bo‘yicha 28 tasi esa ikkinchi yondoshuv bo‘yicha yozilgan. Dastlab tahlilni 1-yondashuv bo‘yicha yozilgan adabiyotlardan boshlaymiz:

- ko‘rsatilayotgan transport xizmatining narx-navosi;
- yuk va yo‘lovchilarni yetkazib berish ishonchliligi;
- yuklarni yetkazib berish texnologiyasi va boshqarilishining turli
- tashish sharoitlari va iste’molchilar talablariga moslashuvchanligi;
- xizmat ko‘rsatishning har tomonlama to‘laligi va ehtiyojni qamrab olishi;
- axborotlashganligi;
- erishish (olish) osonligi (mushkul emasligi).

Bozor iqtisodiyoti sharoitida yuklarni yetkazib berish ishonchliligini ta’minlash muhim ahamiyat kasb etadi.

2-jadval



Xalqaro avtomobillarda tashuvlarda anketa usulidan Transport xizmati sifatini yuqori darajada ta’minlash uchun birinchi navbatda iste’molchilarning yetkazib berish sifatiga qo‘yayotgan talablari va mezonlarini o‘rganish kerak. Buning uchun esa ulardan mazkur masalaga oid o‘y-fikrlarini so‘rab bilish, anketalashtirish, ularning turli nisbiy baholashlarini, ya’ni boshqacha aytganda, transport xizmati sifatiga bo‘lgan talablarning qanday shakllanishi va o‘zgarishini o‘rganish lozim bo‘ladi. Bunda bozorga oid omillar ta’sirini hisobga olish ham muhim rol o‘ynaydi.

3-jadval

Anketa so‘rovi va ma’lumotlarni tahlil qilish tafsilotlari

No.	Elementlar	Tarkib
1	So‘rov usuli	Anketa so‘rovi
2	Namuna olish usuli	Tasodifiy bo‘lmagan tanlov
3	Baholash usuli	Miqdoriy, sifat jihatidan -Ha/Yoq
4		- Ko‘p tanlov -ochiq-yopiq
5	So‘rov vaqti	iyul, 2019
6	Respondentlar soni	Logistika xizmatlarini bilan shug‘ullanuvchilar: 46
7	Ma’lumotlarni qayta ishlash va tahlil qilish vositalari	SPSS (Statistic Package for Social Science)
8		Cronbach Alpha factor (α): $0.6 \leq \alpha < 0.7$: qoniqarli $0.7 \leq \alpha < 0.8$: yaxshi $0.8 \leq \alpha \leq 1.0$, $\alpha \geq 0.8$: juda yaxshi

• “aniq o‘z muddatida” tushunchasi adabiyotlarda bir xil talqin etilmagan;

• ko‘pchilik olim va mutaxassislar “aniq o‘z muddatida” tushunchasin

kontseptual bayon ko‘rinishida yoki semantik darajada keltirganlar, faqat ikki manbada [26, 28] mazkur talab model darajasiga yetkazilgan. Ba’zi bir ilmiyishlarda [28, 29] aniq o‘z muddatida yetkazib berishga oid modellar tavsiya etilgan. Ayrim yondashuvlarda [28] yetkazib berishning haqiqiy muddati bilan rejalashtirilgan muddati orasidagi farqdan kelib chiqadigan yo‘qotishlar narxini kamaytirish (minimallashtirish) masalasi qo‘yilgan bo‘lsa, boshqa ishlarda [29] yetkazib berish muddatining rejalashtirilgan qiymatini bajarish ehtimolini belgilangan darajada ta’minlash mezonini bajarish imkoniyatlari ko‘rib chiqilgan.

Ilmiy adabiyotlarda “yukni aniq o‘z muddatida yetkazishni rejalashtirish” tushunchasi integrallashgan logistikaning asosiy obyekti – logistik sikl parametriga nisbatan qo‘llaniladi. Turli manbalarda quyidagi operatsiyalar logistik siklning bosqichlari sifatida ko‘rsatiladi [26]:

Logistik sikl va uning alohida bosqichlari bajarilish muddatlari turli olimlar tomonidan tahlil etilgan va ularning asarlarida keltirilgan: masalan, D.Dj. Bauersoks, D.Dj. Kloss, Dj. R. Stok, D.M. Lambert va M. Kristofer va boshqalar. Quyidagi 2.3. javdalda mazkur mualliflar asarlarida keltirilgan logistik siklning alohida bosqichlarini bajarishga sarflanadigan vaqt muddatlarini [26] manba ma’lumotlariga asoslanib keltiramiz. Mazkur jadvaldan ko‘rinib turibdiki, logistik siklning asosiy tarkib-bog‘lanishlari, tugunlari va shu kabilar moddiy – texnik ta’minot, ishlab chiqarish va ta’minlash jarayonlari uchun bir xildir. Logistik tizim qanday murakkab bo‘lishidan qat’i nazar muhim bog‘lanishlarni aniqlash uchun alohida logistik siklning (tts) bosqichlari va konfiguratsiyasini tahlil etish kerak.

Logistik siklni tashkil etuvchi vaqt intervallari ma’lum taqsimlanish qonuniyati va parametrlariga ega bo‘lgan tasodifiy kattaliklarni yuzaga keltiradi.

Logistik siklning yuqorida bayon etilgan xususiyatlarini hisobga olgan holda “aniq o‘z muddatida yetqazish” modelini shakllantirish uchun birinchi navbatda quyidagi tahlillarni amalga oshirish lozim bo‘ladi [8]:

1. Logistik siklning tarkibiy tuzilmasini aniqlash joiz. Bunda siklni tashkil etuvchi barcha operatsiyalar va ularni bajarish sxemasini asoslash kerak. Ayrim hollarda bir necha operatsiyalar (masalan, yuklarni komplektlashtirish va ularni rasmiylashtirish) bir vaqtda paralel kanallarda bajarilishi mumkin va ular muddati tasodifiy kattalik sifatida shakllanadi.

2. Logistik siklni tashkil etuvchi operatsiyalarni bajarish muddatlarining tasodifiy taqsimlanishini aniqlashtirish uchun statistik kuzatuvlar o‘tkazish lozim.

3. O‘tkazilgan statistik kuzatuvlar asosida siklni tashkil etuvchi operatsiyalarga sarflanadigan vaqtning har birini tasodifiy taqsimlanish qonuni va parametrlarini aniqlash zarur.

Quyidagi 2.3. rasmda Sh.O. Butayev ilmiy tadqiqot ishlarida logistik siklni tashkil etuvchi operatsiyalarga sarflanadigan vaqtning tasodifiy kattalik sifatidagi taqsimlanish zichligi keltirilgan [8].

4-javdal

Logistik sikl bosqichlariga sarflanadigan vaqt muddatlari

Logistik tsikl bosqichlari	**Logistik tsikl bosqichlari muddati**				
	[30] manbaa		[32] manbaa		[33] manbaa
	Qiymat intervali	Kutilgan qiymat	Qiymat intervali	Kutilgan qiymat	Qiymat intervali
1. Buyurtmani tayyorlash va uzatish t_1	0,5-3	1	0,5-1,5	1	1-5
2. Buyurtmani olish va uni ishlash t_2	1-4	2	1-3	2	1-3
3. Buyurtmani komplektlashtirish va tayyorlash t_3	1-20	2	1-9	1	1-9
4. Buyurtmani tashish, uni chegaralar, bojxonalar va terminallardan olib o‘tish t_4	2-10	4	1-9	3	1-5
5. Buyurtmani oxirgi terminaldan buyurtmachi tashkilotga yetkazib berish t_5	0,5-3	1	0,5-3	1	1-3
Jami	5-40	10	3,5-20	8	5-25

Logistik sikl elementlarining tasodifiy kattalik sifatida taqsimlanish qonunlari va parametrlari (2.3-jadval va 2.2-rasm) aniqlangandan so‘ng quyidagi statistik ko‘rsatkichlarni hisoblash mumkin:

Logistik siklning statistik parametrlarini hisoblash [8].

Logistik siklning o‘rtacha muddati tts uni tashkil etuvchi alohida operatsiyalar o‘rtacha muddatlari ning yig‘indisiga tengdir, ya’ni

$$t_{u} = \sum_{i=1}^{N} \bar{t}_i \; ; \qquad (1)$$

Quyidagi -jadvalda yuklarni yetkazib berish sifatini baholovchi ko‘rsatkichlar, ularni aniqlanish usullari va axborot manbalari ko‘rsatilgan [8].

5-javdal

Yuklarni yetkazib berish sifatini baholovchi ko‘rsatkichlar

Sifatni baholovchi mezon	Ko‘rsatkich	Aniqlanish usuli	Axborot manbai
1	2	3	4
1. Narx-navosi	Xizmatning narxi	Hisoblash, shartnoma	Preyskurant
2. Ishonchlilik 2.1. O‘z muddatida yetkazish	Yetkazib berish muddati	Istiqbolni belgilash usuli, ekspert usuli	Statistik axborotlar

2.2. Yukning saqlanganligi	Yo‘qotilgan yuklar foizi		
2.3. Tavakkalligi darajasi	Buzilgan yuklar hajmi		
	Yo‘qotish hajmi		
2.4. Muvofiqlashgan hamkorlik	Muvofiqlashgan hamkorlikda ishlash vaqti	Istiqbolni belgilash usuli, ekspert usuli	Statistik axborotlar
	Hamkorlikda muvaffaqiyatli amalga oshirilgan loyihalar foizi		
	Aloqalar tizimining mavjudligi		
	Muvofiqlashgan hujjatlashtirish		
	Texnik jihatdan muvofiqlashganlik (tara turlari, qadoqlash, kuzov xillari va sh.k)		
2.5. Yo‘l harakati xavfsizligi	Yo‘l harakati hodisalari soni (bir yildagi transport ishiga to‘g‘ri keladigan)		
2.6. Ekologik xavfsizligi	Zaharlilik va shovqinlik darajalari		
2.7. Obro‘-e’tibor	Firmaning obro‘yi (yillik shikoyatlar soni)	So‘rovlar o‘tkazish	Statistik axborotlar, ommaviy axborot vositalari, xaridorlar va hamkorlar axborotlari
	Ko‘rsatilayotgan xizmatlar sifat darajasi		
	Xodimlarning xayrixohligi va to‘g‘riso‘zligi		
	Xodimlarni kasbiy tayyorgarligi		
	Moliyaviy imkoniyatlari		
	Hamkorlikka intilishi		
3. Tizimning moslashuvchanligi		Marketing metodlari, shartnoma	Shartnomalar, preyskurantlar
3.1. Xizmat ko‘rsatishda (XK)	XKning turli darajalari mavjudligi		
	Etkazib berish sharoitini o‘zgartirish imkoniyati		
3.2. To‘lovlarni amalga oshirishda	Kredit, narx-navoni pasaytirish, to‘lov muddatini uzaytirish		
4. Erishish osonligi		Istiqbolni belgilash usullari	Statistik axborotlar
4.1. XK qulayligi	Buyurtmani qayta ishlash qiyinligi		
4.2. Xizmatga tayyorligi	Bajarilgan ishlar foizi		
5. Axborotlashgani		Istiqbolni aniqlash usullari, ekspert usullari, shartnoma	Statistik axborotlar
5.1. Axborotning aniqligi	Noto‘g‘ri axborotlar foizi		
5.2. Axborot berish tezkorligi	Axborot tayyorlashga ketgan vaqt		
	Bir soatda beriladigan axborotlar soni		
5.3. Axborotlarning to‘laqonligi	Axborot beriladigan masalalar doirasi		
6. Kompleks yondashuv		Marketing usullari, shartnoma	Statistik axborotlar, litsenziyalar
6.1. Asosiy xizmatlar ko‘rsata olish	Xizmat ko‘rsatish turlari		
6.2. Xizmat turlari bo‘yicha ish hajmi	Texnik, axborot, moliyaviy va sh.k. xizmatlar		
6.3. Qo‘shimcha xizmatlar ko‘rsatish imkoniyati	Xizmatlar ro‘yxati (maslahatlar, yuridik, tashkiliy va sh.k xizmatlar)		

Yuqorida keltirilganlarni hal etish uchun ekspertlar tomonidan bir necha usullar A.O.Merenkov tomonidan tavsiya etilgan [11]:

-ekstensiv, yo‘l infratuzilmasini qurish;

-intensiv, transport oqimini optimallashtirish va boshqarishda intellektual transport tizimlari (ITT)ni qo‘llash.

Shuning uchun bu muammoni intellektual transport tizimi sifatli hal etishi mumkin, bunda fan va texnikaning yutuqlaridan samarali foydalaniladi. ITT barcha yo‘l harakati ishtirokchilari uchun ma’lumotlarni yig‘ish, qayta ishlash va yetkazishda zarur bo‘lgan jihozlar, dasturiy ta’minot va tarmoqlarning birlashtirilishi yordamida bunday samaradorlikga erishiladi.

Iqtisodiy hudud yoki mintaqada tashish oqimlarini samarali tashkil etish uchun transport kommunikatsiyalarini optimal joylashtirish va rivojlantirish masalalari doimo olimlar va mutaxassislar diqqat markazida bo‘lgan. Ilgarilari bajarilgan ilmiy ishlarda transport tarmog‘ini rivojlantirishning oqilona variantini izlash muammolari umumiy ko‘rinishda berilmagan. Transport tarmog‘ini kelajakdagi rivojlantirish variantlarini belgilashda chuqur nazariy bilim va tajribaga asoslangan hamda muhandislik ishlanmalari talab etiladi.

Yuk va yo‘lovchi tashishning asosiy vositasi bo‘lgan avtomobil yo‘llari tarmog‘ini optimal rejalashtirish va shu asosda kamxarj yo‘l tarmoqlarini loyihalash asoslari V.N.Obraztsov, D.A.Vulis, V.G. Nezabudkin, A.K. Birulya, va boshqalar ilmiy tadqiqotlarida o‘z aksini topgan.

Olib borilgan tahlillardan ma’lum bo‘ldiki dunyoning ko‘pgina xorijiy va mahalliy olimlarning ishlari xalqaro tashuvlarda yuklarni avtomobil transporti temir yo‘l transporti dengiz transportida yuklarni xalqaro tashishlarda turli parametrlarini tanlash va hisoblash samaradorligini o‘rganishga bag‘ishlangan.

D. Bauersoksning fikricha, an’anaviy usullarga nisbatan yuk tashuvlarini tashkil etishning afzalligi va iqtisodiy samaradorligi masalalarini kiritgan holda multimodal va intermodal yuk tashuvlarini tashkil etish muammolariga alohida e’tibor qaratgan. Shu bilan birga muallif, transport tarmoqlari, transport vositalari va transport

kompaniyalari o‘z ichiga olgan integratsiyalashgan transport tizimini alohida qayd etadi *

S.M. Rezer, o‘z ishida o‘zgarishlar sharoitida mintaqaviy transport tizimlarini boshqarish modeli va muammolari ko‘rib chiqilgan. Mamlakat ishlab chiqarish-transport tizimida transport turlarining o‘zaro ta’sir usullari, transport ishlari bozorini prognozlash metodologiyasi va magistral yo‘l transportida yuklash ishlarini rejalashtirish prinsiplarini to‘liq tahlil etgan [34].

Tashish jarayonini tavsiflovchi umumlashtirilgan mezoni tashishning umumiy xarajatlariga transportning texnologik xarajatlari, ya'ni tashish, yuklash va saqlash vaqtlaridan iborat bo'lgan sarflangan vaqt, shuningdek sug'urta xarajatlari kiradi:

$$Z = \sum C + \sum T \cdot \tau + \sum D, \quad (2)$$

Bu yerda Z – transportning umumiy xarajatlarini bildiradi, sh.p.b.; C – transportning texnologik xarajatlarini bildiradi, sh.p.b.; $T \cdot \tau$ - umumiy vaqt xarajatlarini bildiradi, sh.p.b.; T – tashish, yuklash va saqlash vaqti, soat; τ – vaqt bo'yicha nisbiy xarajatlarni bildiradi, sh.p.b./soat; D – sug'urta xarajatlarini bildiradi, sh.p.b.

A.L. Nosov hozirgi sharoitda xalqaro integratsiyalashgan transport tizimlarining tashkil etilishi va maqbul faoliyat yuritishi muammolari tadqiq etiladi. Xalqaro qatnovlarda aralash tashqi savdo tashuvlarini tashkil etishni takomillashtirish yo‘nalishlarini ko‘rsatgan holda aralash yuk tashuvlarini rivojlantirish istiqbollari alohida ta’kidlaydi

Yuk tashish oqimlarini tarmoqda оптималлаштириш масалаларини ечиш учун **Ye.P. Nesterov, G.N. Kovshov** томонидан мультитармоқ усули taklif etilgan. B.H.Лившитс taklif etgan usulida masala yuk oqimlarini kichik ulushlarda ko‘p marotaba taqsimlash va yoyning differensial tannarxini oraliq qayta hisoblashlar asosida yechilsa, multitarmoq usulida yuk oqimlari taqsimlanishi shartli tarmoqda amalga oshiriladi. Bunda zvenoning har bir yoyi transport tarmog‘i va vositalarining texnik jihozlanishi ko‘zda tutilgan rivojlanish darajasiga mos o‘tkaziladi. Har bir yoyga texnik jihozlanish darajasiga mos o‘tkazish qobiliyati va tannarx xarakteristikasi yoziladi. Bunda differensial xarajat prinsipi qo‘llaniladi, ya’ni oqimning o‘sishiga oid parametrlar keltirilgan xarajat kattaligida o‘z aksini topadi. Yuk oqimlari multitarmoq yoyining o‘tkazish qobiliyatini hisobga olgan holda qisqa yo‘l bo‘yicha taqsimlanadi. O‘tkazish qobiliyati to‘ldirish meyori talabiga javob bergan yoy keyingi hisoblarda qaralmaydi. Keyin esa qolgan yuk oqimlari keyingi qisqa yo‘l bo‘yicha taqsimlanadi. Tashishni kamxarj transport tarmog‘ida amalga oshirish bilan birgalikda uning uzluksizligini ham ta’minlashi uchun avtomobil yo‘lining mahalliy tarmog‘ini rivojlantirishni taqoza etadi. Avtomobil yo‘lining mahalliy tarmog‘i tadqiq etilayotgan hududning ijtimoiy-iqtisodiy rivojlanishini ta’minlashi kerak bo‘ladi. Shuning uchun ilmiy-tadqiqot ishida harakat jadalligi kichik bo‘lgan sharoitlar uchun hudud avtomobil yo‘l tarmog‘ini rivojlantirishning metodikasi asoslangan.

Mamlakatimiz olimlaridan **G.Samatov, A.Zoxidov, A.Gulamov** va **M.Ravshanovlarning** fikricha “transport tizimi – bu yuk va yo‘lovchilarni o‘z manziliga yetkazish jarayonida o‘zaro aloqasi bo‘lgan transport turari va infratuzilmalari majmuasi, ya’ni o‘zaro bog‘liq bo‘lgan transport sektorlari, mehnat resurslari hamda mamlakat iqtisodiyotini samarali bosharish maqsadida transportning barcha turlarini boshqaruv tizimi tushiniladi” [7].

Transport uchastkalarida yuk tashishga kam vaqt sarf etish shartidan kelib chiqib yo‘llarning ayrilish nuqtalarini aniqlashni I.A.Romanenko tavsiya etganligi A.Kuziyev ishlarida keltirib o‘tilgan.

4. Xulosa

Ushbu muammoga bag‘ishlangan maqolalar, konfrensiya ma’ruzalari va magistrlik/PhD/doktorlik dissertatsiyalarida o‘rganilmoqda. Tadqiqot ishida yaxshiroq yechimlarga erishish uchun aniq mezonlarni aniqlash va to‘g‘ri metodologiyani tanlash kerak.

Ushbu tadqiqotda XAT larning muammosi bo‘yicha adabiyotlar quyidagilarga asoslangan holda ko‘rib chiqiladi: nazariy jihatdan qaror qabul qilish texnikasi, qaror mezonlari va amalga oshirish usullari. Ushbu tadqiqotning asosiy maqsadi tadqiqotchilar va soha vakillari uchun XAT larning ahamiyati bo‘yicha tushuncha berish, shuningdek muammoning dolzarblik darajasini ochib berishdan iborat. Shu maqsadda adabiyotlardan 6 ta magistrlik dissertatsiyasi, 4 ta Phd, 6 ta doktorlik va 17 ta ilmiy maqola ko‘rib chiqildi. Ushbu tadqiqot ishidagi tahlillar natijalaridan quyidagilarni xulosa qilish mumkin: Bugungi davr sharoitlaridan kelib chiqib ekologik omillarni ham ko‘proq tahlil etish zarur. Ushbu ilmiy maqola muallifning PhD dissertatsiyasi doirasida tadqiqot ishi Dastlabki bajarilgan ilmiy-tadqiqotlarda tashish-transport tarmog‘i uchastkalari qurishning oddiy holatlarida qo‘llaniladigan analitik, grafik va grafoanalitik usullar ishlab chiqilgan va tavsiya etilgan.

Manzillarni eng qisqa yo‘l bilan bog‘laydigan tashish tarmoqlarini optimal shakllantirish borasida ishlab chiqilgan model va usullar tahlil etilgan.

Tahlilar asosida eng qisqa bog‘lovchi tarmoqlarni biriktirish usulida ko‘rilayotgan uchastka tranzit bo‘lib o‘tayotgan qo‘shimcha yuk oqimi hisobga olinmasligi va bunday holat ko‘zda tutilayotgan tashish xarajatlarini, olinadigan yechim optimalligini sezilarli darajada o‘zgartirishi mumkinligi ko‘rsatib o‘tildi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Samatov G‘affor — Toshkent davlat transport universiteti, “Transport logistikasi” kafedrasi mudiri, i.f.d. prof,
E-mail: transportlogistikasi@mail.ru; Tel: +99897 404 90 56 https://orcid.org/0000-0001-6479-6173

Maxsumov Isroiljon
Toshkent davlat transport universiteti, “Transport logistikasi” kafedrasi assistenti,
E-mail maxsumovisroil1995@gmail.com
Tel: +998990910226
https://orcid.org/0009-0002-7265-361X

Yo‘ldoshev Davron
Toshkent davlat transport universiteti, “Transport logistikasi” kafedrasi PhD katta o‘qituvchisi,
E-mail: davron.yoldoshev@bk.ru
Tel: +998974114169
https://orcid.org/0000-0002-6042-2737

Development of a method for assessing the impact of organizing shunting operations with different numbers of locomotives on the quality indicators of the use of rail transport

D.Ya. Nazhenov[1][a], A.T. Baqoyev[2][b], A.Q. Yusupov[2,3][c], Sh.M. Suyunbayev[2][d]
[1]Karakalpak State University name after Berdakh, Nukus, Uzbekistan
[2]Tashkent state transport university, Tashkent, Uzbekistan
[3]Chirchik branch of the South Kazakhstan Research University named after M. Avezov, Uzbekistan

Abstract: When choosing a rational number of shunting locomotives, one of the main factors is the performance indicators of railway transport. At the same time, the economic efficiency of attracting an additional shunting locomotive is achieved mainly by reducing the working fleet of cars as a result of accelerating technological operations during shunting work. The article develops a method for assessing the impact of organizing shunting operations with different numbers of locomotives on the quality indicators of railway transport operation. Based on the initial data of a conditional junction section station, shunting operations are graphically modeled and economic indicators for using 2 locomotives instead of 1.5 are determined.

Keywords: Junction section station, shunting locomotive, shunting work, sorting of wagons, waiting for technological operations to be performed, quality indicators of railway transport operation

Manyovr ishlarini turli sondagi lokomotivlar bilan tashkil etishning temir yo‘l transportini ishlatish sifat ko‘rsatkichlariga ta’sirini baholash usulini ishlab chiqish

Nazhenov D.Ya.[1][a], Baqoyev A.T.[2][b], Yusupov A.Q.[2,3][c], Suyunbayev Sh.M.[2][d]
[1]Berdaq nomidagi Qoraqalpoq davlat universiteti
[2]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston
[3]M. Auezov nomidagi Janubiy Qozog‘iston ilmiy-tadqiqot universitetining Chirchiq filiali

Annotatsiya: Manyovr lokomotivlarining ratsional sonini tanlashda temir yo‘l transportini ishlatish ko‘rsatkichlari asosiy omillardan biri hisoblanadi. Bunda qo‘shimcha manyovr lokomotivini jalb etishning iqtisodiy samaradorligi asosan manyovr ishlaridagi texnologik amallarni tezlashtirish natijasida tejaladigan vagonlarning ishchi parki orqali olinadi. Maqolada manyovr ishlarini turli sondagi lokomotivlar bilan tashkil etishning temir yo‘l transportini ishlatish sifat ko‘rsatkichlariga ta’sirini baholash usuli ishlab chiqilgan. Shartli uzel uchastka stansiyasining boshlang‘ich ma’lumotlari asosida manyovr ishlari grafoanalitik modellashtirilgan va 1,5 ta o‘rniga 2 ta lokomotiv ishlatishning iqtisodiy ko‘rsatkichlari aniqlangan.

Kalit so‘zlar: Uzel uchastka stansiyasi, manyovr lokomotivi, manyovr ishlari, vagonlarni saralash, texnologik amallar bajarilishini kutib qolish, temir yo‘l transportini ishlatishning sifat ko‘rsatkichlari

1. Kirish

Bugungi kunda vagon aylanmasi ko‘rsatkichini yaxshilash orqali temir yo‘l transportida yuklarni o‘z muddatida iste’molchiga yetkazib berish dolzarb vazifalardan biridir. Buning uchun bir qator ilmiy tadqiqot ishlari olib borilmoqda [1-7]. Biroq, mavjud ilmiy ishlarda manyovr ishlarini yaxshilash hisobiga olinadigan iqtisodiy samaradorlikni baholashda faqat harakatlanuvchi tarkiblarning turib qolishidan va yoqilg‘idan tejaladigan mablag‘larni inobatga olish bilan chegaralangan [8-10]. Amaliyotda vagonlarning turib qolish vaqti qisqarishi natijasida vagon aylanmasi kamayadi va ishchi park tejaladi. Ushbu tadqiqotda vagonlarning ishchi parki tejalishidan olinadigan iqtisodiy samaradorlikni hisobga olgan holda manyovr ishlarini 1,5 va 2 ta lokomotiv yordamida tashkil etishning temir yo‘l transportini ishlatish sifat ko‘rsatkichlariga ta’sirini baholash usulini ko‘rib chiqamiz.

[a] https://orcid.org/0009-0004-4795-1708
[b] https://orcid.org/0009-0003-0655-0448
[c] https://orcid.org/0000-0002-0662-4610
[d] https://orcid.org/0000-0002-4867-8270

2. Tadqiqot metodikasi

Poyezdlar qatnovi jadalligini ta’minlashga poyezdlarning peregondagi harakatlanish vaqti bilan bir qatorda tarkibni saralash va tuzish ishlari ham ta’sir ko‘rsatadi. Saralash stansiyalari poyezdlarni tuzish bilan shug‘ullansa, uchastka stansiyalari yo‘l davomida tarkiblarni ko‘rikdan o‘tishini ta‘minlash uchun xizmat qiladi, shuning uchun uchastka stansiyasida ham saralash ishlari ma’lum miqdorda olib boriladi. Tarkiblarni saralash va poyezdlarni qayta tuzish ishlari uchun manyovr lokomotivlaridan foydalaniladi. Bunda manyovr lokomotivlarining talab etiladigan soni stansiyadagi manyovr ishlarining hajmiga bog‘liq ravishda quyidagicha aniqlanadi:

$$M_{man} = \frac{K_N^M \cdot \Sigma Mt}{L_{vr} \cdot 1440 - (T_{sb} + T_{ek} + T_{tp})}, lok. \quad (1)$$

bunda: K_N^M – hisobot ma’lumotlari bo‘yicha belgilanadigan, manyovr ishlarining sutkalik hajmining nomutanosibligi koeffitsiyenti (1,1 ÷ 1,3);

ΣMt – sutka davomidagi stansiyadagi yoki alohida manyovr rayonlaridagi manyovr ishlarini bajarilishiga sarflanadigan lokomotiv-daqiqalar yig‘indisi, lok.-daq.;

L_{vr} – manyovr ishlaridagi qarama-qarshi marshrutlar tufayli to‘xtalishlarni hisobga oluvchi koeffitsient (0,95 qabul qilindi);

T_{sb} – sutka davomida lokomotiv brigadalarini almashinishiga sarflanadigan vaqt (15 daqiqadan sutkasiga 2 marta, jami 30 daq.);

T_{ek} – sutka davomida manyovr lokomotivini ekipirovkadan o‘tkazilishiga ketgan vaqt sarfi T_{ek} = 60 *daqiqa*

T_{ek} – sutka davomida manyovr lokomotivini ekipirovkadan o‘tkasish uchun sarflanadigan vaqt (60 daq.);

T_{tp} – manyovr lokomotivi ishida texnologik to‘xtalishlarga sarflanadigan umumiy vaqt (50 daq.).

ΣMt parametrni hisoblasning ikki xil usuli mavjud. 1. Manyovr yarim reyslari davomiyligini xronometraj kuzatish orqali hisoblash. 2. Manyovr yarim reyslari davomiyligini yo‘l uzunligi va manyovr tezliklaridan kelib chiqqan holda hisoblash orqali.

Shartli uzel uchastka stansiyasi misolida 2-usul asosida aniqlangani ΣMt miqdori aniqlandi (1-jadval).

1-jadval

Lokomotivlar bilan barcha turdagi manyovr ishlarini bajarilishiga ketgan sutkalik vaqt sarfi

T/r	Bajariladigan texnologik amallar	O‘lchov birligi	Soni	Vaqt me’yori, daqiqa	Lokomotiv-daqiqa sarflari
	1	2	3	4	5
1	Poyezdlarni saralash (tarqatish)	poyezd	14	29	406
2	Bir guruhli poyezdlarning tuzilishini tugallash	poyezd	11	18	198
3	Ko‘p guruhli poyezdlarning tuzilishini tugallash	poyezd	4	46	184
4	Tarkiblarni saralash parkidan qabul qiliqr-jo‘natish parkiga olib o‘tish	poyezd	15	10	150
	Jami				938
5	Vagonlarni yuk hovlisiga uzatish va olib chiqish	uzatish	2	50	100
	Vagonlarni shoxobcha yo‘liga uzatish va olib chiqish	uzatish	2	49	98
	Jami				198
	Umumiy				1126

1-jadval va (1) formula asosida manyovr lokomotivlarining talab etiladigan soni 1,21 ni tashkil etishini ko‘rish mumkin. Amaliyotda ushbu miqdordagi lokomotivlar soni mavjud bo‘lmasligini hisobga olib, manyovr lokomotivlaridan foydalanishning 2 ta variant kelib chiqadi:

I variant: 1-lokomotiv 24 soat davomida stansiyadagi manyovr ishlarini bajarsa, 2-lokomotiv esa 12 soat ishlaydi;

II variant: 2 ta lokomotiv ham 24 soat davomida stansiyadagi manyovr ishlarini bajaradi.

1-jadvalda keltirilgan manyovr yarim reyslarining davomiyligi va 2-4-jadvallardagi qabul qilinadigan poyezdlar haqida ma’lumotlar asosida asosida stansiyaning sutkalik ish reja-grafigini I va II variantlar bo‘yicha ishlab chiqildi. Bunda quyidagilar e‘tiborga olindi:

1. Bir yo‘llik peregondan qabul qilinuvchi va jo‘natiluvchi poyezdlar kesishishiga yo‘l qo‘ymaslik.
2. Har bir parkda bittadan texnik va tijoriy ko‘rik brigadasi ishlashini hisobga olib, bir vaqtda har bir parkda ikki yoki undan ortiq tarkiblarni texnik va tijoriy ko‘rikdan o‘tkazmaslik.
3. Saralash parkida tarkib tayyor bo‘lgach tarkibning tuzilishi tugallab, saralash parkidan qabul qilish-jo‘natish parkiga olib o‘tilayotganda ushbu saralash yo‘liga vagon tushirmaslik.
4. Ishlayotgan ikkala lokomotiv uchun soat 8:00 va 20:00 dan 15 daqiqalik lokomotiv brigadalari almashish vaqtini belgilash.
5. Saralash parkida to‘liq yig‘ilgan tarkiblarni imkon qadar tezroq tuzilishini tugallab, qabul jo‘natish yo‘llariga o‘tkazish.

2-jadval

“D” stansiyasi tomonidan qabul qilinadigan poyezdlar haqida ma’lumot

T/r	Kelish vaqti	Poyezd raqami	Poyezd turi*	Poyezd tarkibdagi keladigan vagonlar										
				I	K	L	M	O	E	J	N-I	N-E	YX	Shy
0 soatga qolgan vagonlar				8	7	6	11	13	6	13				
1	6-27	3003	q.ish.	44	4								5	7
2	7-23	2003	tr					60						
3	8-42	3007	q.ish.	8				19		9	3	13	5	3
4	9-35	2005	tr					60						

5	10-34	2007	tr					60						
6	14-42	3413	q.ish.			14	14	17			15			
7	14-58	2009	tr					60						
8	15-46	2011	tr							60				
9	16-00	2013	tr					60						
10	17-09	3021	q.ish.		16	12		2	7	2	10	11		
11	18-42	3023	q.ish.	7			14		4	18		17		
12	21-00	3025	q.ish.	15	10	6	6	8	8		7			
13	22-38	185	pas	0										
14	23-21	2017	tr					60						
15	23-29	2019	tr							60				

*q.ish. – qayta ishlanadigan tranzit poyezdlar; tr. – qayta ishlanmaydigan tranzit poyezdlar

3-jadval

“I” stansiyasi tomonidan qabul qilinadigan poyezdlar haqida ma’lumot

T/r	Kelish vaqti	Poyezd raqami	Poyezd turi	Poyezd tarkibdagi keladigan vagonlar										
				A	B	V	G	D	E	J	N-D	N-E	YX	Shy
0 soatga qolgan vagonlar				10	6	6	3	10						
1	0-12	3204	q.ish.		22		2			23			4	9
2	3-30	2204	tr	60										
3	3-43	3208	q.ish.	5	7	14		3	2		12	11	4	2
4	5-38	2206	tr	60										
5	11-00	3432	q.ish.	14	2		10	5	9	6	7	7		
6	11-39	3214	q.ish.	13	20	5			6			16		
7	11-47	2208	tr	60										
8	11-58	2210	tr	60										
9	14-41	2212	tr							60				
10	15-24	3222	q.ish.	21		12			15		12			
11	16-12	2214	tr	60										
12	18-03	186	pas	0										
13	20-03	2218	tr	60										
14	20-14	2220	tr						60					
15	21-08	2222	tr	60										
16	21-48	2224	tr	60										
17	22-43	2226	tr	60										
18	22-54	2228	tr						60					

4-jadval

“E” stansiyasi tomonidan qabul qilinadigan poyezdlar haqida ma’lumot

T/r	Kelish vaqti	Poyezd raqami	Poyezd turi	Poyezd tarkibdagi keladigan vagonlar													
				A	B	V	G	D	I	K	L	M	O	N-D	N-I	YX	Shy
0 soatga qolgan vagonlar																	
1	1-10	2103	tr										60				
2	2-31	2105	tr	60													
3	3-50	2107	tr										60				
4	6-30	2109	tr	60													
5	14-07	3111	q.ish.		3			20	11		12				14		
6	16-55	3453	q.ish.	9		16	2	16	17								
7	18-36	3115	q.ish.		18		6	15		15		2	4				
8	20-48	2111	tr										60				
9	23-02	2113	tr	60													

Uchastka stansiyasida manyovr ishlarini 1,5 va 2 ta lokomotiv yordamida tashkil etishning temir yo‘l transportini ishlatish sifat ko‘rsatkichlariga ta’sirini baholash quyidagi ifodalar asosida amalga oshirilishi mumkin:

- qayta ishlanmaydigan tranzit vagonlarning o‘rtacha turish vaqti.

$$t_{tr}^{q-m.ish} = \frac{\Sigma(N_{tr} \cdot t_{tr}^{tr} + t_{kut.tr}) \cdot m_{tr}}{\Sigma N_{tr} \cdot m_{tr}}, soat \quad (2)$$

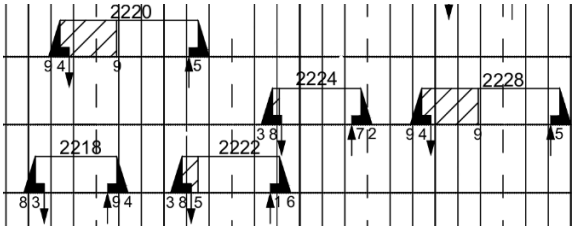
bunda: N_{tr} – stansiyadan qayta ishlovsiz o‘tuvchi tranzit poyezdlati soni (2-3-4-jadvallarga muvofiq $N_{tr} = 26\ \ ta$)

t_{tr}^{tr} – stansiyadan qayta ishlovsiz o‘tuvchi tranzit poyezdining ishlovdan o‘tkazilishiga sarflangan meyoriy vaqt (36 daqiqa qabul qilindi);

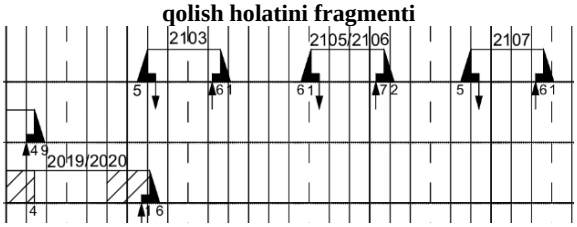
$t_{kut.tr}$ –ishlovdan o‘tish, lokomotivni ulash va poyezdning jo‘natilishini kutib turishiga sarflangan vaqt, daq. (sutkalik ish reja-grafigidan olinadi);

m_{tr} – tranzit poyezdining tarkibidagi vagonlar soni (2-4-jadvallarga muvofiq 60 ta vagon).

$t_{kut.tr}$ ning miqdori asosan texnik va tijoriy ko‘rikdan o‘tkazishga jalb etilgan brigadalar soni va peregonning bandligiga bog‘liq (1-2-rasmlar).



1-rasm. Juft yo‘nalishdan keluvchi 2220, 2222, 2224 va 2228-transit qayta ishlanmaydigan poyezdlarining texnik va tijoriy ko‘rik brigadasi bo‘shashini kutib qolish holatini fragmenti



2-rasm. Toq yo‘nalishdan kelib, juft yo‘nalishga jo‘natiluvchi 2019/2020-transit qayta ishlanmaydigan poyezdining peregonning bo‘shashini kutib qolish holatini fragmenti

- qayta ishlovga tushuvchi tranzit poyezdining stansiyada o‘rtacha turish vaqti elementlarga ajratilgan holda quyidagi ifoda orqali aniqlanadi:

$$t_{tr}^{q.ish} = t_{qq} + t_{tar} + t_{yig'} + t_{t.t} + t_{jo'n},\ soat \qquad (3)$$

bunda: t_{qq} – texnologik amallarni bajarishda uning o‘rtacha turish vaqti, soat;

t_{tar} – tarkibni saralashga sarflanadigan vaqt (1-jadvalga muvofiq 29 daqiqa yoki 0,48 soat);

$t_{yig'}$ – bitta vagonning saralash parki yo‘lida yig‘ilishda turgan o‘rtacha vaqti, soat;

$t_{t.t}$ – tarkibni tuzilishini tugallanishiga va uni saralash parkidan qabul qilib jo‘natish parkiga olib qo‘yishga sarflanadigangan o‘rtacha vaqt, soat;

$t_{jo'n}$ – vagonlarning jo‘natilishi bo‘yicha o‘rtacha turish vaqti, soat.

t_{qq} ning miqdori quyidagicha aniqlanadi:

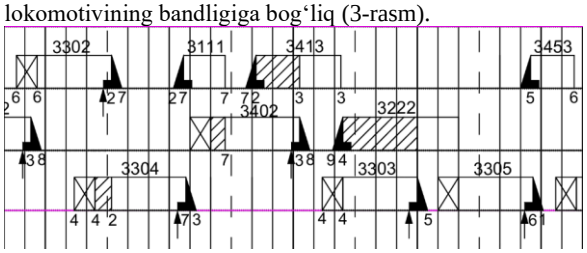
$$t_{qq} = \frac{\Sigma(N_{q-ish}\cdot t_{obr}+t_{kut})\cdot m_t}{\Sigma N_{q-ish}\cdot m_t},\ soat \qquad (4)$$

bunda: N_{q-ish} saralashga kelayotgan tarkibning texnik ko‘rigi davomiyligining meyori;

$t_{t.t}$ – saralashga kelayotgan tarkibning texnik ko‘rigi davomiyligining meyori (20 daqiqa qabul qilindi);

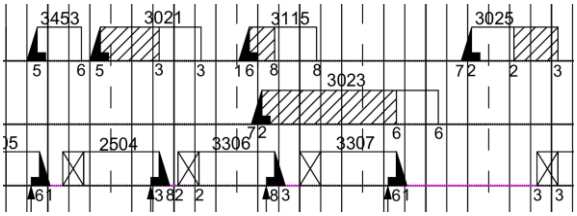
$t_{kut.q}$ – tarkibning texnik ko‘rigi va saralanishini kutish vaqti, daq. (sutkalik ish reja-grafigidan olinadi).

$t_{kut.q}$ning miqdori asosan texnik va tijoriy ko‘rikdan o‘tkazishga jalb etilgan brigadalar soni va manyovr lokomotivining bandligiga bog‘liq (3-rasm).

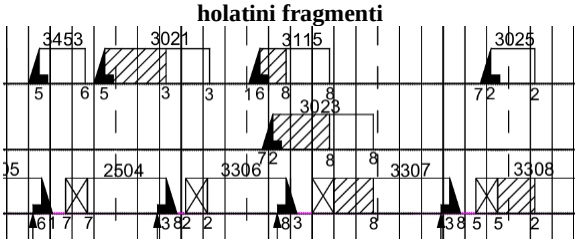


3-rasm. 3413, 3222-tranzit qayta ishlanadigan poezdlarning qabul qilish-jo‘natish parkida texnik va tijoriy ko‘rikdan o‘tkazishga jalb etilgan brigadalar bo‘shashini kutib qolish holatini fragmenti

3-rasmdan ko‘rinib turibdiki, tarkiblarni texnik va tijoriy ko‘rikdan o‘tkazishga jalb etilgan brigadalarini kutib qolish vaqti foydalanilayotgan lokomotivlar soniga bog‘liq emas. Ushbu turdagi kutib qolish vaqtlarini kamaytirish uchun qo‘shimcha brigadalar guruhini shakllantirish talab qilinadi. $t_{kut.q}$miqdorining lokomotivlar soniga bog‘liqligini 4 va 5-rasmlardan ko‘rish mumkin.



4-rasm. 1,5 lokomotivdan foydalanishda 3023 va 3025-tranzit qayta ishlanadigan poezdlarning manyovr lokomotivi tomonidan saralanishini kutib qolish holatini fragmenti



5-rasm. 1,5 ta lokomotiv o‘rniga 2 ta lokomotivdan foydalanishda 3023-poezdning manyovr lokomotivi tomonidan saralanishini kutib qolishining kamayishi va 3025-poezdning kutish qolishi bartaraf etilishi holatini fragmenti

4-5-rasmlardan xulosa qilish mumkinki, manyovr lokomotivlari sonining oshishi nafaqat stansiyadagi texnologik amallarning bajarilishini tezlashtirish, balki qabul qilish-jo‘natish parkida tarkiblarning saralanishini kutish vaqtining kamayishiga ham olib keladi.

$t_{yig'}$ning miqdori quyidagicha aniqlanadi:

$$t_{yig'} = \frac{\Sigma B_{yig'}}{\Sigma n_{yig'}} = \frac{\Sigma n_{yig'}\cdot t_M}{\Sigma n_{yig'}},\ soat \qquad (5)$$

bunda$\Sigma B_{yig'} - \Sigma B_N$ – yig‘ilish vagon – soatlar yig‘indisi;

$\Sigma n_{yig'}$ – yig‘ilish jarayonida qatnashayotgan vagonlarning umumiy soni.

$$\Sigma B_N = \Sigma B_N^{o't.} + \Sigma B_N^{uch.} + \Sigma B_N^{ter.};\ vag-soat \qquad (6)$$

bunda: $\Sigma B_{yig'}^{o'tk.}$ – o‘tkinchi poyezdlarning yig‘ilish vagon-soatlari, vag.soat (sutkalik ish reja-grafigidan olinadi).

$\Sigma B_{yig'}^{uch.}$ – uchastka poyezdlarning yig‘ilish vagon-soatlari, vag.soat (sutkalik ish reja-grafigidan olinadi).

$\Sigma B_{yig'}^{ter.}$ – terma poyezdlarning yig‘ilish vagon-soatlari, vag.soat (sutkalik ish reja-grafigidan olinadi).

$t_{t.t}$ – ning miqdori quyidagicha aniqlanadi:

$$t_{t.t} = \frac{(N_{uch}+N_{o't})\cdot t_{t.t}^{o't,uch}+N_{ter}\cdot t_{t.t}^{ter}+(N_{uch}+N_{o't}+N_{ter})\cdot t_{o-q}+\Sigma t_{kut.q}}{N_{uch}+N_{o't}+N_{ter}},\ soat \qquad (7)$$

bunda: N_{uch} – uchastka poyezdlarning soni. poyezd; (sutkalik ish reja-grafigidan olinadi).

$N_{o't}$ – o‘tkinchi poyezdlarning soni. poyezd; (sutkalik ish reja-grafigidan olinadi).

N_{ter} – terma poyezdlarning soni. poyezd; (sutkalik ish reja-grafigidan olinadi).

$t_{t.t}^{o't,uch}$ – o‘tkinchi va uchastka poyezdlari bilan tuzishni tugallashga sarflanadigan vaqt miqdori. (1-jadvalga muvofiq 18 daqiqa qabul qilindi);

$t_{t.t}^{ter}$ – terma poyezdlari bilan tuzishni tugallashga sarflanadigan vaqt miqdori. (1-jadvalga muvofiq 46 daqiqa qabul qilindi);

t_{o-q} – saralash parkidan qabul qilish-jo‘natish parkiga poyezdlarni o‘tkazishga sarflanadigan vaqt miqdori. (1-jadvalga muvofiq 10 daqiqa qabul qilindi);

$\Sigma t_{kut.q}$ – saralash parkida to‘liq yig‘ilgan tarkibni qabul qilish-jo‘natish parkiga olib o‘tilishini o‘tkazishga sarflanadigan vaqt miqdori. (1-jadvalga muvofiq 10 daqiqa qabul qilindi);

$t_{jo'n}$ –quyidagi formula orqali aniqlanadi:

$$t_{jo'n} = \frac{\Sigma\left(N_{tuz.} \cdot t_{t.t.k}^{jo'n} + t_{kut.}\right) m_t}{N_{tuz} \cdot m_t}, soat \quad (8)$$

bunda: $N_{tuz.}$ – stansiyaning o‘zida tuzilgan poyezdlar soni, poezd (sutkalik ish-reja grafigidan olinadi);

$t_{t.t.k}^{jo'n}$ – stansiyaning o‘zida tuzilgan poyezdlarning jo‘natilishi bo‘yicha ishlovda turgan o‘rtacha vaqti (36 daqiqa qabul qilindi);

$t_{kut.}$ – tarkibga ishlov berish, lokomotivni ulanishi va poyezdning jo‘natilishini kutish vaqti.

Stansiyaning vagonlar ishchi parki quyidagicha aniqlanadi:

$$n_p = \frac{n_{tr}^{q-m.ish} \cdot t_{tr}^{q-m.ish} + n_{tr}^{qish} \cdot t_{tr}^{q-ish} + n_M \cdot t_M}{24}, vag. \quad (9)$$

bunda: n_M – mahalliy vagonlar soni, vagon (2-4-jadvallardan olinadi);

t_M – mahalliy vagonlarning o‘rtacha turish vaqti, soat (sutkalik ish-reja grafigidan olinadi).

Manyovr lokomotivlaridan foydalanish koeffitsienti quyidagicha aniqlanadi:

$$K_{lok} = \frac{\Sigma t_{band}}{M \cdot \left(1440 - \left(T_{sb} + T_{ek} + T_{tp}\right)\right)} \quad (10)$$

bunda: Σt_{band} – manyovr lokomotivining sutka davomida ishlagan vaqt miqdori, daq. (sutkalik ish-reja grafigidan olinadi).

3. Xulosa

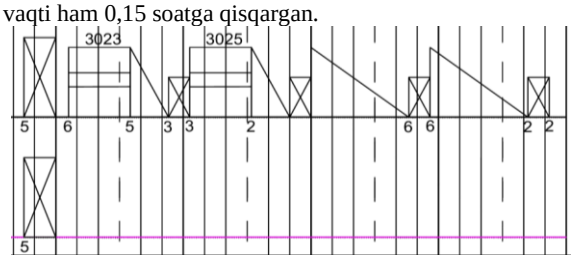
Shartli uzel uchastka stansiyasi ishi yuqorida keltirilgan boshlang‘ich ma’lumotlar asosida grafoanalitik modellashtirildi. Natijada 1,5 va 2 ta lokomotiv yordamida manyovr ishlarini tashkil etishdagi temir yo‘l transportini ishlatishning sifat ko‘rsatkichlari aniqlandi (5-jadval).

5-jadval

1,5 va 2 ta lokomotiv yordamida manyovr ishlarini tashkil etishdagi temir yo‘l transportini ishlatishning sifat ko‘rsatkichlari

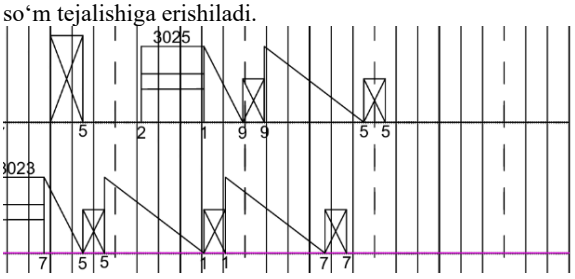
T/r	Ko‘rsatkishlar nomi	Shartli belgilar	O‘lchov birligi	1-variant (1,5 ta lokomotiv)	2-variant (2 ta lokomotiv	Farqi
1.	Qayta ishlanmaydigan tranzit vagonlarning o‘rtacha turish vaqti	t_{mp}^{bp}	soat	0,75	0,75	0
2.	Qayta ishlanadigan tranzit vagonlarning o‘rtacha turish vaqti	t_{tr}^{sp}	soat	7,85	7,45	0,4
3.	Tranzit vagonining o‘rtacha turish vaqti	t_{tex}	soat	3,35	3,2	0,15
4.	Vagonlar ishchi parki	n_r	vag.	366	351	15
5.	Birinchi manevr lokomotivlaridan foydalanish koeffitsienti	K_{lok}^{I}	-	0,57	0,51	0,06
6.	Ikkinchi manevr lokomotivlaridan foydalanish koeffitsienti	K_{lok}^{II}	-	0,66	0,35	0,31

5-jadvaldan ko‘rinib turibdiki, qayta ishlanmaydigan tranzit vagonlarning o‘rtacha turish vaqti manyovr lokomotivlari soniga bog‘liq emas hamda qayta ishlanadigan tranzit vagonlarning o‘rtacha turish vaqti 0,4 soatga kamaygan. Bunga asosan 1,5 ta lokomotivning tungi smenada ishlamasligini oldini olish orqali erishilgan (6-7-rasmlar). O‘z navbatida, tranzit vagonlarning o‘rtacha turish vaqti ham 0,15 soatga qisqargan.



6-rasm. 1,5 lokomotivdan foydalanishdagi manyovr lokomotivining ish ko‘rsatkichlari (2-lokomotiv faqat kunduzgi smenada ishlaydi)

Bitta tranzit qayta ishlanadigan vagonning turib qolish vaqti o‘rtacha 0,4 soatga qisqarishi natijasida sutkasiga 878 ta tranzit qayta ishlanadigan vagonlardan 351,2 vagon-soat tejaladi. Bir vagon-soat xarajatlar stavkasi 976 so‘mni tashkil etishini hisobga olsak, bitta tranzit qayta ishlanadigan vagonning turib qolish vaqti qisqarishi natijasida sutkasiga 342771 so‘m, yiliga esa 125,11 mln. so‘m tejalishiga erishiladi.



7-rasm. 2 lokomotivdan foydalanishdagi manyovr lokomotivining ish ko‘rsatkichlari

5-jadvaldan ko‘rinib turibdiki, 2-lokomotivni sutka davomida ishlatish (1,5 ta lokomotiv o‘rniga 2 ta lokomotivdan foydalanish) natijasida vagonlarning ishchi parki 15 taga tejalishiga erishiladi. Quyuv mexanika zavodi tomonidan taqdim etilgan ma’lumotlarga ko‘ra bitta yangi ishlab chiqarilgan vagonning narxi 724 mln. so‘mni tashkil etadi. Shunday qilib, vagonlarning ishchi parkidan 10,86 mlrd. so‘m tejalishiga erishiladi hamda jami iqtisodiy samaradorlik tranzit qayta ishlanadigan vagonning turib

qolish vaqti qisqarishi natijasida olinadigan 125,11 mln. so‘m bilan birgalikda 10,98 mlrd. so‘mni tashkil etadi.

Ma’lumki, 1,5 ta lokomotiv o‘rniga 2 ta lokomotivdan foydalanish lokomotiv brigadalari (mashinist va uning yordamchisi) uchun bir oyda yarim smenalik oylik ish haqi va yoqilg‘i bo‘yicha joriy saqlash xarajatlarini keltirib chiqaradi. Lokomotivlardan foydalanish boshqarmasi tomonidan berilgan ma’lumotlarga ko‘ra hozirgi kunda bitta lokomotiv brigadasining ish haqi o‘rtacha 37,4 mln. so‘mni tashkil etadi. Demak, yarim smena uchun ish haqining miqdori 18,7 mln. so‘m bo‘lganda jami qo‘shimcha yillik ish haqi bo‘yicha xarajatlar 224,4 mln. so‘mga teng bo‘ladi.

Yarim smena davomida manyovr lokomotivlari tomonidan ishlatiladigan yoqilg‘i xarajatlarini “Temiryo‘linfratuzilma” AJ Toshkent mintaqaviy temir yo‘l uzeli filialidan olingan meyorlarga asoslangan holda aniqlaymiz. Ushbu filila tomonidan 2024 yil mart oyi uchun taqdim etilgan meyorlarga muvofiq mayonvr lokomotivlari uchun smenalik o‘rtacha yoqilg‘i miqdori 120 litrni tashkil etgan. Demak, qo‘shimcha smena davomida bitta manyovr lokomotivi bir yilda 43800 litr yoqilg‘i sarflaydi. O‘zbekiston Respublikasi tovar-xom ashyo birjasining 19 sentabr holatiga berilgan ma’lumotlariga ko‘ra bir litr yoqilg‘i narxi 14453 so‘mni tashkil etadi [11]. Demak, qo‘shimcha smenalik manyovr ishlarini tashkil etish natijasida bir yilda 633,04 mln. so‘m xarajat talab etiladi. Shunday qilib, 1,5 ta lokomotiv o‘rniga 2 ta lokomotivdan foydalanish natijasida joriy saqlash xarajatlari bir yilda 857,44 mln. so‘mni tashkil etadi. Shunday qilib, manyovr lokomotivining qo‘shimcha yarim smenalik ishini tashkil etish natijasida bir yilda 10,12 mlrd. so‘m foyda olinishiga erishiladi.

1,5 ta lokomotiv o‘rniga 2 ta lokomotivdan foydalanish nafaqat joriy saqlash, balki manyovr lokomotivini xarid qilish bilan bog‘liq bo‘lgan kapital xarajatlarni ham keltirib chiqaradi. Lokomotivlardan foydalanish boshqarmasi taqdim etgan ma‘lumotlarga ko‘ra bitta manyovr teplovozining narxi 19,12 mlrd. so‘mni tashkil qiladi va bu kapital xarajatlar sifatida qabul qilinishi mumkin. Tadqiqot natijasida manyovr lokomotivining qo‘shimcha yarim smenalik ishini tashkil etish tavsiya etilganligini e’tiborga olib, kapital xarajatlarni ikkiga bo‘lish maqsadga muvofiqdir (ikkinchi yarim smenada boshqa stansiya yoki terminallarda foydalanilishi mumkin). Ko‘rinib turibdiki, manyovr lokomotivining qo‘shimcha yarim smenalik ishini tashkil etishning o‘zini oqlash muddati 0,94 yilni tashkil etadi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Dautbay Yakubbaevich Nazhenov	Berdaq nomidagi Qoraqalpoq davlat universiteti “Shahar qurilishi va xo‘jaligi” kafedrasi katta o‘qituvchisi E-mail: dawitnajenov@gmail.com Tel.: +998972201407 https://orcid.org/0009-0004-4795-1708
Baqoyev Alisher Tel‘mon o‘g‘li	Toshkent davlat transport universiteti “Transport tizimlari boshqaruvi” fakulteti talabasi E-mail: Baqoyeva08@gmail.com Tel.: +998940066200 https://orcid.org/0009-0003-0655-0448
Yusupov Azizjon Qaxramonovich	Toshkent davlat transport universiteti “Temir yo‘ldan foydalanish ishlarini boshqarish” kafedrasi katta o‘qituvchisi, texnika fanlari bo‘yicha falsafa doktori (PhD)

	E-mail: yusupovaziztosh@gmail.com Tel.: +998990439737 https://orcid.org/0000-0002-0662-4610	
Suyunbaev Shinpolat Mansuraliyevich	Toshkent davlat transport universiteti “Temir yo‘ldan foydalanish ishlarini boshqarish” kafedrasi professori,	texnika fanlari doktori (DSc), professor E-mail: shinbolat_84@mail.ru Tel.: +99893 510 92 82 https://orcid.org/0000-0002-4867-8270

Improving methods to reduce inefficient time losses under speed limit conditions at JSC “Uzbekistan Railways”

N.M. Aripov[1][a], N.S. Tohirov[1][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: In this article, the conditions under which train speed is limited are examined, including the circumstances and amounts of speed restrictions for issuing warnings. It discusses the delivery of warning forms to train drivers and methods to reduce inefficient time losses of trains. The effectiveness of the proposed schemes for organizing warnings under planned and unplanned circumstances, as well as improving operational safety, is also described. [2].

Keywords: warnings, request, telegraph, station dispetcher, automated system, train movement schedule, warning form, train driver, section (between two stations), route

“O‘zbekiston temir yo‘llari” AJda tezlik cheklangan sharoitlarda unumsiz vaqt yo‘qotishlarini kamaytirish usullarini takomillashtirish

Aripov N.M.[1][a], Toxirov N.S.[1][b]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Ushbu maqolada poyezdlar harakat tezligi cheklangan sharoitlarda ogohlantirishlar qaysi holatlarda va cheklangan tezlikning miqdorlari, poyezd mashinistlariga ogohlantirish blankalarini yetkazishda, poyezdlarning unumsiz vaqt yo‘qotishlarini kamaytirish usullari tadqiq qilingan. Rejadagi va rejadan tashqari ogohlantirishlar berilgan sharoitlarida, taklif etilayotgan sxemalar asosida tashkil etish samaradorligi va harakat xavfsizligini oshirsh haqida bayon qilingan.

Kalit so‘zlar: ogohlantirishlar, talabnoma, telegraf, stansiya navbatchisi, avtomatlashtirilgan tizim, poyezdlar harakati grafigi, ogohlantirish blankasi, poyezd mashinisti, peregon, yo‘nalish

1. Kirish

Rejalashtirilgan ogohlantirishlar berishga talabnoma bayon etilgan telegrammalar (telefonogrammalar) shunday hisob-kitob bilan jo‘natilishi lozimki, ogohlantirish berish stansiyasining navbatchisi tomonidan ogohlantirish amalga kirishi paytidan kamida 3 soat oldin qabul qilinishi, poyezdlar to‘xtovsiz 3 soatdan ortiq harakatlanadigan yo‘nalishlarda esa AJ boshqaruvi raisi tomonidan belgilangan muddatdan ilgari qabul qilinishi haqida “O‘zbekiston Respublikasi temir yo‘llarida poyezdlar harakati va manyovr ishlari bo‘yicha” yo‘riqnomada belgilab qo‘yilgan. Tahlil natijalarining ishonchliligini va ayrim bo‘linmalar va mutaxassislarning, birinchi navbatda lokomotiv brigadalarining ish sifatini baholashning ob’ektivligini oshirish bo‘yicha chora-tadbirlarni ishlab chiqish uchun quyidagilar bo‘lishi kerak, tezlik cheklovlari, poyezdlarning kechikishi va to‘xtashlar ularning harakatlanish vaqti ta’sirini aniqlashning quyidagi usul yordamida aniqlanadi. [15-16].

2. Tadqiqot metodikasi

Belgilangan manzillar bo‘yicha talabnomalar, telegramma va telefonogrammalarni o‘z vaqtida yetkazilishini ta’minlaydigan, ogohlantirishlarni o‘rnatish yoki bekor qilish xaqidagi talabnomalar, telegramma yoki telefonogrammalarni yuborish tartibi AJ boshqaruvi raisi tomonidan belgilanadi.

Talabnoma ijroga qabul qilinganiga quyidagilar tasdiq bo‘ladi:

a) belgilangan manzillarga jo‘natish uchun telegramma qabul qilib olingani xaqida telegraf xodimi (telegraf bo‘lmagan joyda - stansiya navbatchisi) imzo chekkan telegramma (telefonogramma) nusxasi yoki matnida uni belgilangan manzillarga yetkazishning qayd etilgan vaqti, ushbu telefonogrammani qabul qilgan xodimning lavozimi va familiyasi ko‘rsatiladi;

b) ogohlantirishlar berish stansiyasi navbatchisining yozma talabnoma olganligi to‘g‘risida yoki ushbu stansiya navbatchisining ogohlantirishlar kitobida talabnoma bergan xodimning yozuvi ostidagi imzosi. [15-16].

Temir yo‘l transportida poyezdlar harakatini raqamli texnologiyalar asosida tashkil etish va shakllantirish bu intellektual aloqaning to‘liq integratsiyasi foydalanuvchilar va raqamlashtirilgan tizim o‘rtasidagi texnologiyalar transport va infratuzilmani boshqarish va harakat xavfsizligini ta’minlash imkonini beradi.

Poyezdlar harakatini ushbu tizimlar asosida tashkil qilinsa quyidagilarga imkon beradi

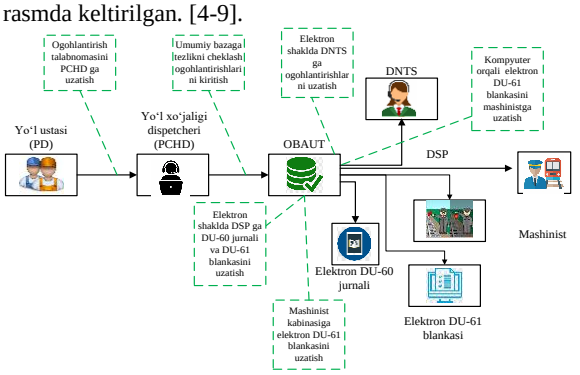
temir yo‘l transportining uzluksiz barqaror ishlashini;

[a] https://orcid.org/0000-0002-6209-5063
[b] https://orcid.org/0000-0003-1385-9263

tashish jarayonlarini, harakatlanuvchi tarkiblarning holatini va eng muhimi, poyezdlar harakati xavfsizligini ta’minlash.[10-13].

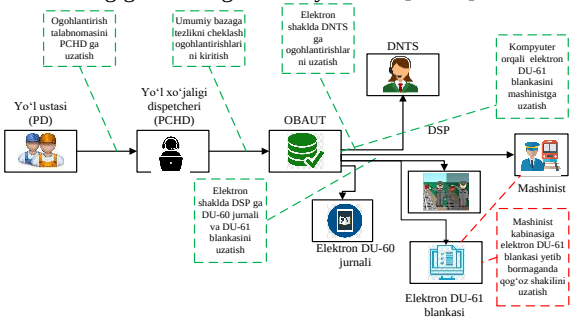
Xavfsizlikni ta’minlashning asosiy va muhim jihati bu poyezdlar harakatida tezlikni cheklash ogohlantirishlarini o‘z vaqtida berish hisoblanadi. Hozirgi kunda temir yo‘l tarmog‘ida, ogohlantirishlarni berishga telegrammalar sonining ko‘payishi bilan ogohlantirishlar berishda inson omili jarayonni tashkil etishda sezilarli ta’sir ko‘rsatadi.

Ushbu xavflarning oldini olish uchun temir yo‘l transportida ogohlantirishlarni berish va bekor qilishda avtomatlashtirilgan tizimni ishlab chiqish va joriy etishga talab borligini ko‘rishimiz mumkin. Avtomatlashtirilgan tizimni joriy qilinishi tashish jarayonida harakat xavfsizligini ta’minlashda samarali ekanligini ko‘rishimiz mumkin. Poyezdlarga beriladigan ogohlantirishlarni avtomatlashtirilgan tizimi ya’ni, “Ogohlantirishlarni berishning avtomatlashtirilgan uzatish tizimi” (OBAUT)1–rasmda keltirilgan. [4-9].



1-rasm. Rejalashtirilgan navbatdagi ogohlantirishlarni uzatish chizmasi

Reja bo‘yicha beriladigan ogohlantirishlarning uzatish sxemasi quyidagi tartibda olib boorish, ma’lumotlarni uzatish vaqt sarfini kamaytirish imkonini beradi. Hozirgi mavjud tizimdagi samarasiz vaqt yo‘qotishlarini tejash ish samardorligiga oshrishga zamin yaratadi. [11-14].



2-rasm. Ish boshlanishidan 3 soat oldin uyatiladigan (navbatdagi) ogohlantirishlarni uzatish tizimining chizmasi

Poyezdlar harakatini tashkil etish bo‘yicha ilmiy ishlar tahlili shuni ko‘rsatadiki, bir qator ilmiy ishlar harakat tezliklarini hisoblashda yuk poyezdlari yo‘nalishi bo‘yicha qiyalliklarni hisobga olish, stansiyaning texnik va texnologik jarayonlari, vagon oqimlarini rejalashtirish, texnik me’yorlardan maksimal darajada foydalanish, temir yo‘l infratuzilmasini hisobga olgan holda harakat tezliklarini cheklash, stansiya yo‘llarining rahbar nishabliklariga asosan manyovr yarimreyslari samarali variantini tanlash va yuk tashish tizimida vagonli jo‘natmalarning sutkalik bosib o‘tgan masofasini asoslash usullariga bag‘ishlangan. Bu ishlar tezlik cheklangan sharoitlarda poyezdlar harakatini tashkil etishning ayrim jihatlarini ochib beradi. Biroq, unumsiz vaqt yo‘qotish xususiyatlarini aniqlash va kamaytirishning umumiy yondashuvlari taklif etilmagan. Shundan kelib chiqib, unumsiz (t_{unum}) vaqt yo‘qotishlarni hisobga olish, tahlil qilish va ularni guruhlarga ajratgan holda yangicha yondashuv taklif etilmoqda. Shuningdek, ushbu yondashuv stansiyalarda ogohlantirish blankalarini tayyorlash, poyezd mashinistiga yetkazish, poyezdlar bilan bajariladigan texnologik amallar, PHG, TFQ, PHMIBY bo‘yicha poyezdlar harakatini tashkil etish uchun texnologik me’yorlarga mos kelishi kerak.

PHGning asosiy ko‘rsatkichlarining bajarilishi uchun (p_y) peregonlarda 1-ifoda samarasiz vaqt yo‘qotishlar davomiyligini hisobga oladigan $(t_{per}^{rad}, t_{per}^{nish}, t_{per}^{ogoh}, t_{per}^{\inf}, t_{per}^{xavfli})$ parametrlarni kiritish taklif etiladi:

$$t_{per}^{yur} = t_{per}^{rad} + t_{per}^{nish} + t_{per}^{ogoh} + t_{per}^{inf_{per}^{xavfli}} \quad (1)$$

1-jadval

bu yerda t_{per}^{rad} –	peregonlardagi burilish radiuslaridan o‘tish uchun sarflanadigan vaqt, daqiqa;
t_{per}^{nish} –	peregonlar bo‘yicha rahbar nishabliklarni bosib o‘tish uchun sarflanadigan vaqt, daqiqa;
t_{per}^{ogoh} –	peregonlarda ta’mirlash uchun beriladigan ogohlantirish masofalarini bosib o‘tishga sarflanadigan vaqt, daqiqa;
$t_{per}^{\inf}$ –	temir yo‘l yo‘nalishlari bo‘yicha infratuzilmasining geografik joylashuviga ko‘ra poyezdlar harakatini cheklanishi masofalariga sarflanadigan vaqt, daqiqa;
t_{per}^{xavfli} –	peregonlarda nosozliklar kuzatilganda ogohlantirishlarni poyezd mashinistiga yetkazishda sarflanadigan vaqt, daqiqa.

$$t_{per}^{nish} = \frac{l_{nish}}{\vartheta_{nish}^{o'rt}}, daqiqa, t_{per}^{nish} = \frac{l_{nish}}{\vartheta_{nish}^{o'rt}}, daqiqa$$

$$t_{per}^{ogoh} = \frac{l_{ogoh}}{\vartheta_{ogoh}}, daqiqa, t_{per}^{inf_{\vartheta_{inf}, daqiqa,}^{l_{inf}}} \quad (2)$$

$$t_{per}^{blanka} = \frac{l_{xavfli}}{\vartheta_{yur}^{o'rt}}, daqiqa$$

Peregonlarda ta’mirlash ishlari va doimiy omilarni hisobga olgan holda me’yorlash bo‘yicha burilish radiusining masofasi (l_{rad}) va o‘rnatilgan tezligi (ϑ_{rad}), rahbar nishabliklarning masofasi (l_{nish}) va o‘rtacha tezligi (ϑ_{nish}), ogohlantirishlar masofasi (l_{ogoh}) va o‘rnatilgan tezligi (ϑ_{ogoh}), temir yo‘l infratuzilmasining $(\vartheta_{\inf})$ geografik joylashuvi, (l_{xavfli}) nosozlik aniqlangan joygacha qolgan masofa, $(\vartheta_{xavfli}^{o'rt})$ nosozlik aniqlangan joygacha harakatlanish tezligi PHG asosiy ko‘rsatkichlari asos qilib olindi.

Peregonlarda ta’mirlash ishlari va doimiy omillar xususiyatlarini hisobga olgan holda quyidagi ifoda bo‘yicha aniqlanadi [3]

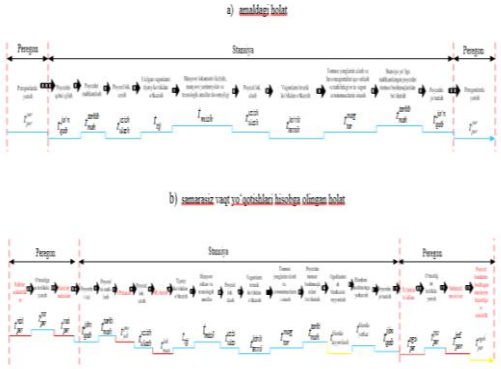
$$t_{yur} = \frac{L - \sum_{i=1}^{\chi} l_i^{ogoh}}{\vartheta_{yur}} + \sum_{i=1}^{\chi}\left[\frac{l_i^{ogoh}}{\vartheta_i^{ogoh}} + t_i^{tez}\left(1 - \frac{\vartheta_i^{ogoh}}{\vartheta_{yur}}\right) + t_i^{sek}\left(1 - \frac{\vartheta_i^{ogoh}}{\vartheta_{yur}}\right)\right], daqiqa. \quad (3)$$

bu yerda: l_i^{ogoh} – temir yo‘l yo‘nalishlaridagi peregonlarda “ogohlantirishlar” berilgan *i*-ta hududlar uzunligi, km;

ϑ_i^{ogoh} – poyezdlarning peregonlarda “ogohlantirishlar” berilgan *i*-ta hududlarda harakatlanish tezliklari, km/soat;

$t_i^{tez/sek}$ – poyezdlarning “ogohlantirishlar” berilgan *i*-ta hududlarda tezlashish va sekinlashish vaqtlari, soat.

Temir yo‘l yo‘nalishlarida PHTni me’yorlashda unumsiz vaqt yo‘qotishlarining peregonlar bo‘yicha xususiyatlari 3-rasmda ko‘rsatilgan. Temir yo‘l uchastkalari va yo‘nalishlari tarkibidagi peregonlarda yuk poyezdlari yurish tezligini me’yorlashda unumsiz vaqt yo‘qotish xususiyatlarini kiritish ko‘rsatilgan 3-rasm. Ushbu peregonlarda yuk poyezdlari yurish tezliklarining unumsiz vaqt yo‘qotishlari xususiyatlarini hisobga olgan holda me’yorlashtirilgan. Yuk poyezdlari yurish tezliklarini me’yorlash uchun kiritilgan parametrlar PHG da yuk poyezdlari harakatini aniq vaqt me’yorlari bo‘yicha tashkil etish imkoniyatini yaratadi.



3-rasm. Peregon va oraliq stansiyalarda yuk poyezdlarining samarsiz vaqt yo‘qotishlari

Temir yo‘l transportida PHTga ta’sir ko‘rsatuvchi omillar guruhi

oraliq va texnik stansiyalari ishida unumsiz vaqt yo‘qotishlariga olib keladi. Bunda unumsiz vaqt yo‘qotishlari xususiyatlari quyidagicha ifodalandi.

$$t_{sam} = t_{yo'l}^{poy} + t_{man}^{lok} + t_{tayyorlash}^{blanka} + t_{yetkazsih}^{blanka}, daqiqa \quad (4)$$

bu yerda $t_{yo'l}^{poy}$ – yuqori tezlikdagi yo‘lovchi poyezdlarni o‘tkazib yuborish uchun sarflanadigan vaqt, daqiqa;

t_{man}^{lok} – oraliq stansiyada manyovr lokomotivlarining kelishini kutib turish uchun sarflanadigan vaqt, daqiqa;

$t_{tayyorlash}^{blanka}$ – stansiyalarda DU-61 blankasini yozishga sarflanadiga vaqt, daqiqa;

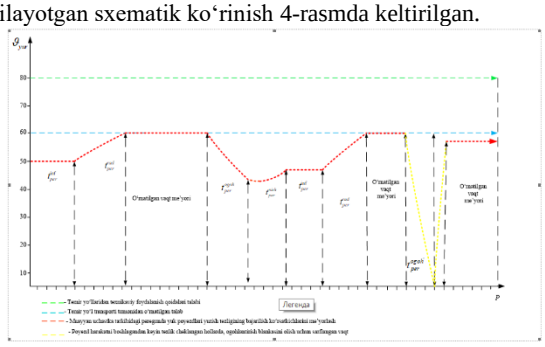
$t_{yetkazsih}^{blanka}$ – poyezd mashinistlari ogohlantirish blankalarini kutib qolishiga sarflanadiga vaqt, daqiqa.

Temir yo‘l yo‘nalishlari bo‘yicha yuqori tezlikda harakatlanuvchi yo‘lovchi poyezdlar harakati ko‘p bo‘lgan uchastkalar tarkibidagi oraliq stansiyalarda yuk poyezdlarining turib qolish vaqti $(t_{yo'l}^{poy})$ me’yorlari ortib borishiga sabab bo‘ladi. Temir yo‘l uchastkalari va yo‘nalishlarida bajariladigan mahalliy ishlar hajmidan kelib chiqib, oraliq stansiyalarga manyovr lokomotivlari biriktiriladi. Jumladan, muayyan bir nechta oraliq stansiyalariga mahalliy ishlar uchun manyovr lokomotivlari biriktiriladi.

Uchastkalarda vagonlar oqimi o‘zgaruvchanligini hisobga olib, ayrim holatlarda manyovr lokomotivini kutib turishi (t_{man}^{lok}) ga sabab bo‘ladi. Ushbu holatlarda stansiyalarda poyezdlarni belgilangan me’yorlaridan ortiq turib qolishi va unumsiz vaqt yo‘qotishlariga olib keladi.

Temir yo‘l transporti uchastkalarida rejadan tashqari kuzatilgan nosozliklar, ya’ni poyezd harakatni boshlagandan keyin tezlik cheklangan hollarda, poyezd mashinistlariga ogohlantirish blankasini yetkazish uchun poyezdlarni grafikda ko‘zda tutilmagan stansiyalarda to‘xtashiga sabab bo‘ladi. Unumsiz vaqt yo‘qotishlari bu, $t_{tayyorlash}^{blanka}$ ogohlantirish blankasini tayyorlashga sarflanadigan vaqt, $t_{yetkazsih}^{blanka}$ DU-61 blankasini poyezd mashinistiga tekazish uchun sarflanadigan vaqt, bu esa stansiya park va yo‘llarining joylashuviga qarab aniqlanadi.

Poyezdlarning temir yo‘l uchastkalari tarkibidagi oraliq stansiyalarda texnologik amallarga sarflanadigan vaqt me’yorlari va unumsiz vaqt yo‘qotishlariga sabab bo‘luvchi xususiyatlari hisobga olgan holda hisoblash uchun taklif etilayotgan sxematik ko‘rinish 4-rasmda keltirilgan.



4-rasm. Peregon va oraliq stansiyalarda yuk poyezdlarining harakat chizmasi

Oddiy sharoitlarda poyezdlar harakati grafigiga muvofiq tashkil etiladi, ya'ni, grafikda belgilangan me’yoriy yurish tezligiga asosan. Bunday hollarda, energiya xarajatlari o‘rtacha harakat tezligi va tezlikning o‘zgarishi, profil va yo‘l rejasi, poyezd holati, geografik sharoitlar va boshqalar bilan belgilanadi.

Tashish jarayonlarida, ko‘p hollarda poyezdlarning tezligi, kechikishi va to‘xtashida turli xil tezlikni cheklash bo‘yicha ogohlantirishlar mavjud bo‘lib, ular poyezdlarning yo‘lda yurish vaqtiga, harakatlanish tezligiga sezilarli darajada ta’sir qiladi.

Tezlikni cheklash ogohlantirishlari asosan yo‘lning qoniqarsiz holati yoki ta'mirlanishi, grafikda ko‘zda tutilmagan joylarda to‘xtash va kechikishlar poyezdlar harakatining qoniqarsiz tashkil etilishi, texnik vositalarning ishlamay qolishi, kutilmagan vaziyatlarda va joylarda paydo bo‘lishi va boshqalar bilan bog‘liq bo‘ladi.

Cheklangan tezlik, poyezdlarning kechikishi va to‘xtashlishlarning harakatlanish vaqtiga ta’sirini ilmiy

asoslangan metodologiyasi yo‘qligi sababli, poyezdlar harakati grafigining bajarilishini, ularning yurish sharoitlarini tahlil qilishda odatda vaqt yo‘qotishlarining o‘rtacha me'yorlaridan foydalaniladi. Tezlik cheklovlari, poyezdlarning kechikishi va to‘xtashlariga sabab bo‘luvchi eng katta omil hisoblanadi.

Aslida, bu yo‘qotishlar har bir poyezd uchun har xil bo‘lishi mumkin, chunki ular ko‘plab foydalanish omillarga bog‘liq bo‘ladi: og‘irlik, tezlik va sharoitlar poyezdning harakatlanishi, uni boshqarish tartib qoidalari, profil, yo‘l rejasi va tezligi cheklangan uchastkalarning uzunligi, to‘xtash va kechikish davomiyligi, geografik omillar va boshqalar.

Tezlik cheklanganda vaqt yo‘qotishlar

Umuman olganda, $T_{to'x}$ poyezdining tezligi cheklanishi, kechikishi yoki to‘xtashidan vaqt yo‘qotishlari, T_{chek} cheklangan tezlik sababli, kechikish yoki to‘xtash, ma'lum bir uchastkada kamaytirilgan tezlikda harakatlanish vaqtidagi farqni anglatadi, T_{phg} poyezdning poyezdlar harakati grafigida belgilangan tezlik bilan harakatlanishiga sarflanadigan vaqt.

$$T_{to'x} = T_{chek} - T_{phg} \quad (5)$$

Poyezdning harakatlanish vaqti balansini tahlil qilish shuni ko‘rsatadiki, tezlikni cheklashdan vaqtni yo‘qotish, sekinlashuv va tezlashuv yo‘qotishlarini hisobga olmasdan, (6) ifoda bilan tavsiflanadi. [1-2]

$$T_{to'x} = (L_{chek} + L_{poyezd})\left(\frac{1}{V_{chek}} - \frac{1}{V_{phg}}\right) = L_{chek,poyezd}\left(\frac{1}{V_{chek}} - \frac{1}{V_{phg}}\right), \quad (6)$$

Bu yerda,

L_{chek}, L_{poyezd} - tezlik cheklangan joy va poyezd uzunligi;

$L_{chek,poyezd}$ - uchastkadagi tezlik cheklangan joyning va poyezdning umumiy uzunligi;

V_{chek}, V_{phg} - cheklangan va poyezdlar harakati grafigidagi me’yoriy tezlik.

Vaqt yo‘qotilishi sekinlashishda t_{sek} va tezlashish t_{tez} harakat tezligining pasayishi va oshishi bilan bilan belgilanadi:

$$t_{sek} = 2\cdot\left(\frac{V_{phg} - V_{chek}}{2\mu_{sek}}\left(1 - \frac{V_{chek}}{V_{phg}}\right)\right); t_{tez} = \frac{V_{phg} - V_{chek}}{2\mu_{sek}}\left(1 - \frac{V_{chek}}{V_{phg}}\right), \quad (7)$$

Poyezdning tezlanishi sekinlashganda poyezdlar harakatining tezlashishi μ_{sek} va tezlashganda tezlanish μ_{tez} ni hisoblashda (8) ifoda orqali hisoblash mumkin:

$$\mu_{sek} = \frac{V_{phg}^2 - V_{chek}^2}{2\cdot L_{sek}}; \mu_{tez} = \frac{V_{phg}^2 - V_{chek}^2}{2\cdot L_{tez}}, \quad (8)$$

Bu yerda:

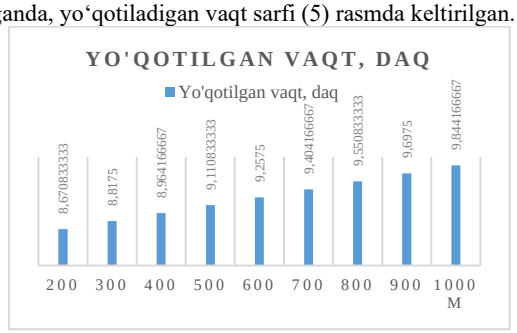
L_{sek}, L_{tez} - poyezd tezligini pasaytirish va tezlashtirish uchun yo‘l uzunligi.

Poyezdning tezlanishi sekinlashganda poyezdlar harakatining tezlashishi $\mu_{sek} = 0,25 m/s^2$ va tezlashganda tezlanish $\mu_{tez} = 0,1 m/s^2$ deb qabul qilinadi:

Poyezdning sekinlashishi va tezlashishini hisobga olgan holda, tezlik chegarasidan vaqtni yo‘qotish quyidagi ifoda bilan tavsiflanadi:

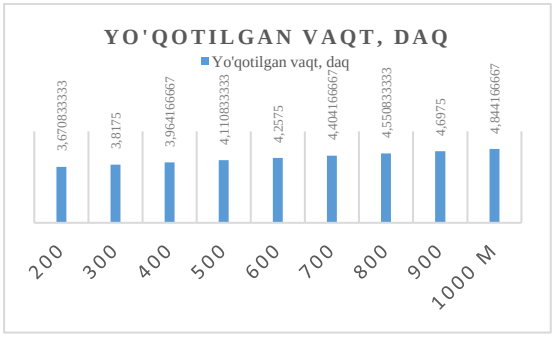
$$T_{to'x} = L_{chek,poyezd}\left(\frac{1}{V_{chek}} - \frac{1}{V_{phg}}\right) + \frac{(V_{phg} - V_{chek})^2}{2\cdot V_{phg}}\left(\frac{1}{\mu_{sek}} + \frac{1}{\mu_{tez}}\right), \quad (9)$$

PHG da belgilangan tezlik $V_{phg} = 80$ km/s, cheklangan tezlik esa $V_{ch.t.} = 25$ km/s, ogohlantirish blankasini olish uchun sarflanadigan vaqt sarf esa $t_{to'x} = 5$ daqiqani tashkil etganda, yo‘qotiladigan vaqt sarfi (5) rasmda keltirilgan.



5-rasm. Samarasiz yo‘qotilgan vaqt blankani yetkazish uchun 5 daqiqa qo‘shilganda

PHG da belgilangan tezlik $V_{phg} = 80$ km/s, cheklangan tezlik esa $V_{ch.t.} = 25$ km/s, ogoglantirish blankasini olish uchun sarflanadigan vaqt sarf esa $t_{to'x} = 0$ daqiqani tashkil etganda, yo‘qotiladigan vaqat sarfi (6) rasmda keltirilgan.



6-rasm. Samarasiz yo‘qotilgan vaqt blankani yetkazish uchun vaqt qo‘shilmaganda

Poyezdning kechikishi va grafikda ko‘zda tutilmagan to‘xtashidan, shuningdek tezlikni cheklashdan kelib chiqadigan vaqt yo‘qotishlari sekinlashish va tezlashish, pasaytirilgan tezlikda harakatlanish yoki to‘xtash vaqti uchun vaqt yo‘qotishlaridan iborat bo‘lib, ular past tezlikda harakatlanish qismining uzunligiga, poyezd holatiga va boshqa omillarga bog‘liq bo‘ladi. Keyingi harakatlanish imkoniyatlari tezlik chegarasidan keyingi kabi bo‘lishi mumkin.

3. Xulosa

Yuqoridagi rasmdan ko‘rinib turibdiki Nazarbek-Dalaguzar peregonini oghlantirishlar berilganida poyezdlar amalda 20 daqiqa vaqt sarflamoqda, lekin PHG da peregonni bosib o‘tish uchun 8 daqiqa qilib belgilangan. Poyezdlar peregonni bosib o‘tishida vaqt sarfining oshishi asosan poyezd mashinistlari ogohlantirish blankalarini kutib qolishi sabab bo‘lmoqda. Agarda ogohlsntirish blankalarini avtomatlashtirilgan tizim orqali uzatiladigan bo‘lsa o‘rtacha

7-8 daqiqa yoki shu vaqt mobaynida peregonda yana bir poyezdni o‘tkazishga imkon beradi.

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Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Aripov Nazirjan	Toshkent davlat transport universiteti “Avtomatika va telemexanika” kafedrasi professori. t.f.d.. E-mail: aripov1110@gmail.com Tel.: +998 90 933 10 93 https://orcid.org/0000-0002-6209-5063
Nosirjon Tohirov	Toshkent davlat transport universiteti “Avtomatika va telemexanika” kafedrasi doktaranti. E-mail: nosirtohirov@gmail.com Tel.:+998998708193 https://orcid.org/0000-0003-1385-9263