

MUHANDISLIK

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ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal

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05.00.00 – Texnika fanlari

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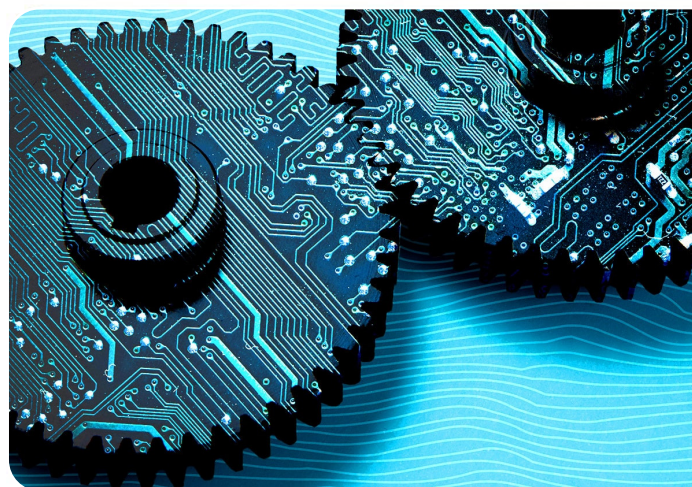
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ТАШКЕНТСКИЙ ФИЛИАЛ



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- 05.01.00 – Axborot texnologiyalari, boshqaruv va kompyuter grafikasi
- 05.01.01 – Muhandislik geometriyasi va kompyuter grafikasi. Audio va video texnologiyalari
- 05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
- 05.01.03 – Informatikaning nazariy asoslari
- 05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
- 05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
- 05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
- 05.01.07 – Matematik modellash
- 05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
- 05.02.00 – Mashinasozlik va mashinashunoslik
- 05.02.08 – Yer usti majmualari va uchish apparatlari
- 05.03.02 – Metrologiya va metrologiya ta'minoti
- 05.04.01 – Telekommunikatsiya va kompyuter tizimlari, telekommunikatsiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
- 05.05.03 – Yorug'lik texnikasi. Maxsus yoritish texnologiyasi
- 05.05.05 – Issiqlik texnikasining nazariy asoslari
- 05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
- 05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
- 05.08.03 – Temir yo'l transportini ishlatish
- 05.08.06 – "G'ildirakli va gusenisali mashinalar va ularni ishlatish" (texnika fanlari)
- 05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
- 05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
- 10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
- 10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti
- 08.00.01 – Iqtisodiyot nazariyasi
- 08.00.02 – Makroiqtisodiyot
- 08.00.03 – Sanoat iqtisodiyoti
- 08.00.04 – Qishloq xo'jaligi iqtisodiyoti
- 08.00.05 – Xizmat ko'rsatish tarmoqlari iqtisodiyoti
- 08.00.06 – Ekonometrika va statistika
- 08.00.07 – Moliya, pul muomalasi va kredit
- 08.00.08 – Buxgalteriya hisobi, iqtisodiy tahlil va audit
- 08.00.09 – Jahon iqtisodiyoti
- 08.00.10 – Demografiya. Mehnat iqtisodiyoti
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- 08.00.12 – Mintaqaviy iqtisodiyot
- 08.00.13 – Menejment
- 08.00.14 – Iqtisodiyotda axborot tizimlari va texnologiyalari
- 08.00.15 – Tadbirkorlik va kichik biznes iqtisodiyoti
- 08.00.16 – Raqamli iqtisodiyot va xalqaro raqamli integratsiya
- 08.00.17 – Turizm va mehmonxona faoliyati

Ma'lumot uchun, OAK

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ECONOMIC SOLUTIONS OF THE COLLECTOR SYSTEM FOR THE EFFECTIVE USE OF THE UNDERGROUND ENVIRONMENT IN URBAN PLANNING

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Abstract: The widespread use of the work carried out in developed countries on multifunctional collectors as a strategic solution for optimizing urban infrastructure in urban planning will bring the field of underground engineering networks to a new level. This article compares a number of engineering options for placing underground engineering networks under pedestrian walkways (sidewalks) and roads based on a collector system from an urban planning and economic point of view, and recommends their implementation in a coordinated manner, taking into account the location of existing underground and above-ground structures.

Keywords: multi-functional collectors, economic optimization, placement under sidewalks, placement under highways, collector installation in cities, urban planning requirements.

Annotatsiya: Shahar infratuzilmasini optimallashtirishning strategik yechimi sifatida ko'p funksiyali kollektorlar bo'yicha rivojlangan davlatlarda olib borilgan ishlarni shaharsozligida keng qo'llashishi yer osti muhandislik tarmoqlariga soxasida yangi bosqichga chiqaradi. Ushbu maqolada yer osti muhandislik tarmoqlarini piyodalar yo'lagi (trotuar), avtomobil yo'llari ostiga kollektor tizimi asosida joylashtirish bo'yicha, bir qator muxandislik variantlari, shaharsozlik, iqtisodiy tamondan solishtiradi va ulardan foydalanishda mavjud yer osti va yer usti inshootlarining joylashuvini xisobga olgan holda muvofiqlashtirilgan tarzda amalga oshirish tavsiya qilinadi.

Kalit so'zlar: ko'p funksiyali kollektorlar, iqtisodiy optimallashtirish, piyodalar yo'lagi ostiga joylashtirish, avtomobil yo'llari ostiga joylashtirish, shaharlarda kollektorni barpo etish, shaharsozlik talablari.

Аннотация: Широкое применение разработанных в развитых странах многофункциональных коллекторов в качестве стратегического решения для оптимизации городской инфраструктуры в городском планировании выведет область подземных инженерных сетей на новый уровень. В данной статье сравнивается ряд инженерных вариантов размещения подземных инженерных сетей под пешеходными дорожками и дорогами на основе коллекторной системы с точки зрения городского планирования и экономики, а также предлагаются рекомендации по их скоординированному внедрению с учетом расположения существующих подземных и надземных сооружений.

Ключевые слова: многофункциональные коллекторы, экономическая оптимизация, размещение под тротуарами, размещение под автомагистралями, установка коллекторов в городах, требования градостроительства.

INTRODUCTION

Among the capital cities of Central Asia, Tashkent is the capital of the Republic of Uzbekistan, with a population of over 3.5 million. Taking into account the expansion of the city, we can see that a city is being built for about 2 million



additional residents within the framework of the “New Tashkent” project. It is known that in the era of development, construction technologies, population growth, and the construction of new cities lead to an increase in the level of load on underground engineering networks (electricity and telecommunications, hot water, cold water supply, and sewage).

The current state of the underground environment in cities and the development of urban planning and the development of rational use of underground space are the basis for developing urban planning solutions.

It is recommended to widely use the collector system to effectively use the urban potential of the underground space by improving the accounting of existing underground structures (engineering networks) in the city.

In recent years, an intensive rise in the groundwater level has been observed in the territory of Tashkent city (geology and hydrogeology) [15]. Factors such as a rise of up to 2-7 meters in some places or the formation of a layer of loose soil up to 31 meters, i.e., pure soil, have led to the deformation of buildings and structures. To study the causes of this phenomenon, it is necessary to take into account the role of structures (metro, water, sewerage, and collector-drainage networks) that adequately reflect the hydrogeological conditions in the city, and the influence of these factors in the formation and reconstruction of the city's natural environment.

Today, the daily volume of wastewater in the city is 1.5–1.8 million m³ [6]. It is known that the existing underground engineering networks and collector systems in use in the city are more than 50 years old and are in need of repair. At the same time, we can see that the wear and tear of pipelines has exceeded 50%. An average of 69 km of pipelines need to be repaired every year, which in turn leads to high economic costs due to a number of factors, such as periodic road closures and traffic diversions during the repair of existing networks in the city [13].

REVIEW OF LITERATURE ON THE SUBJECT

The study of underground engineering networks and multifunctional collector systems has been widely addressed in both international and local scientific literature, reflecting their growing importance in modern urban planning. In developed countries, researchers emphasize the strategic role of underground space in optimizing urban infrastructure. In particular, Canto-Perello (2009) highlights that multifunctional underground collectors significantly enhance the efficiency, safety, and sustainability of urban engineering systems. His research demonstrates that integrated collector systems reduce operational risks, improve maintenance accessibility, and are especially effective in complex geological and seismic conditions.

Similarly, the work of A. P. Moser and Steven Folkman (2008) focuses on the structural and economic aspects of underground pipeline systems, providing fundamental principles for the design and durability of buried infrastructure. Their findings confirm that properly designed underground systems can significantly extend service life while reducing long-term maintenance costs.

In the context of post-Soviet and Central Asian urban development, E. A. Shchukina (2010) investigates the methodological foundations for accounting and managing underground structures. Her work underlines the importance of systematic monitoring and data integration for ensuring the reliability and sustainability of underground engineering networks.

Local scholars have also made substantial contributions to the study of urban engineering infrastructure. The works of A. T. Xotamov and Q. T. Usmonov (2014; 2019) examine the complex development of urban territories, including transportation systems and engineering networks. These studies primarily focus on the planning, modernization, and functional organization of water supply, sewage, and road infrastructure within urban environments. Likewise, I. S. Shukurov et al. (2014) analyze the engineering preparation of urban areas, emphasizing the technical and organizational aspects of infrastructure development.

More recent studies by N. M. Orazbayeva and Z. X. Qosimov (2024–2025) provide a comprehensive assessment of the current state of underground engineering networks in Uzbekistan. Their research identifies key challenges, including the obsolescence of existing systems, inefficient spatial distribution, and the lack of integrated planning approaches. In particular, Usmonov and Orazbayeva (2025) propose optimization methods for placing engineering networks under urban streets, highlighting the economic and functional limitations of traditional trench-based construction methods.

Furthermore, recent publications in international journals (Orazbayeva & Usmonov, 2025) emphasize modern approaches to underground network placement, integrating economic evaluation with urban planning considerations. These studies suggest that multifunctional collector systems offer a promising alternative, enabling more efficient use of underground space and reducing environmental and economic costs.

Despite these contributions, the existing body of literature reveals certain limitations. Most local studies focus primarily on the general condition and modernization of water supply and sewage systems, without providing detailed technical descriptions, placement models, or comprehensive economic calculations for multifunctional collectors. This gap indicates the need for more in-depth research that integrates engineering, economic, and urban planning perspectives.

Therefore, the present study aims to address these shortcomings by proposing detailed placement options and conducting economic analyses of multifunctional collector systems. The findings contribute to the development of

more efficient and sustainable urban infrastructure solutions, demonstrating that the use of multifunctional collectors is economically more advantageous compared to traditional open trench methods.

RESEARCH METHODOLOGY

The traditional trench construction of urban utilities further exacerbates these problems [2]. Multifunctional underground collectors, on the other hand, reduce the risk of damage to utilities by integrating all utilities into one structure, increasing their durability, and simplifying maintenance. However, in densely populated areas such as Tashkent and seismically active areas, the placement of a collector system with underground utilities under a pedestrian walkway (sidewalk) or a roadway (carriageway) remains an unresolved urban planning and economic problem. Placing utilities under a pedestrian walkway does not affect traffic flow and reduces costs, while placing them under a roadway can increase durability, but is costly and complicated.

Inside the collector system, a network of cables is placed step by step and layer by layer on one side of it [1]. On the other hand, pipe networks (drinking water network, hot water network, heating pipes, gas pipes, and other pipes) are laid layer by layer. And in the lower part of the collector, if the relief slope is satisfactory, the sewage network can be installed. If the relief slope of the collector does not provide for students, sewage networks are placed separately outside the collector.

When building a collector in cities, the following urban planning requirements must be met:

- dense location of large consumer buildings and structures;
- shortness of the distance in the transmission of communication networks;
- industrialization level of the city;
- level of engineering development of the city;
- perfection of city street and road networks;
- high level of protection of payments in the field of urban household economy based on state legislation.

Collector systems are mainly used in cases where it is necessary to regulate underground structures and when it is not possible to place a certain number of networks directly on the ground due to planning conditions [1]. The design of collectors provides access for continuous monitoring of underground structures and their timely repair. The laying of underground networks in common transit collectors naturally requires much higher economic costs than placing them in trenches [6]. However, practice in urban planning shows that these costs are fully covered by their costs during operation, eliminating the need to restore road surfaces without damaging them during repair work, without disrupting the appearance of city streets, roads, and pedestrian walkways, and without disrupting the movement of vehicles and pedestrians.

ANALYSIS AND RESULTS

Research on multifunctional collectors has been carried out mainly in the following developed countries: Singapore, Dubai, and Tokyo, and has been widely used in urban planning [8]. Separate placement has been widely used in urban planning in Central Asia and Uzbekistan. Currently, new research is required to optimize the construction of modern cities and their placement in dense urban conditions, based on world experience. By comparing both options, taking into account the specific natural conditions of Tashkent, it is possible to present economically optimal proposals [9].

Today's requirements for the design and operation of collectors are based on safety, automation, and environmental standards [8]. Collectors are divided into general (for various networks), specialized, or industrial types. They are placed under corridors or green areas, and there are some restrictions on placement near children's institutions. Security systems: access control, video surveillance, gas and fire alarms, ventilation systems, monitoring of the internal temperature of the collector (temperature 5-30°C), and emergency exits every 300 m. must be provided (Figure 1) [12].



Parameter (Construction, Annual maintenance, Annual exploitation, Accident risk Additional Effects)	
Pedestrian walkway at the bottom	Street network below
Pedestrian walkway at the bottom	Street network below
12.5 billion soums	18.75 billion soums
0,52 billion soums	0,83 billion soums
1.04 billion soums	1.56 billion soums
2,08 billion soums	3,12 billion soums
25%	25%

Figure 1. Comparison of placing collectors under street roads and under sidewalks

Based on the table above, $L=1\text{km}$ as shown in Table 1, we can see the average cost per length of collector. 18.75 bln. 12.5 billion soums, and the option of placing it under the footpath is soums. It can be seen that, taking into account the total construction costs and the expansion of the city territory, the placement of engineering networks in the collectors has been shown to be more effective from an economic point of view.

CONCLUSIONS AND SUGGESTIONS

The results of scientific research have shown that:

- Placing the collector system under the pedestrian walkway reduces the initial construction costs by 20–25%, and the annual operation and maintenance costs by 30–35%.
- It is recommended to introduce a collector system with an extended service life of up to 100 years through the modernization of collectors.
- In terms of saving drinking water, it was determined that in one year, the trench method can save 30%, and in the case of using the collector system, 5%, that is, 25% of the amount of water per year.
- Urban planning, design, and construction of underground structures in cities should be carried out in a coordinated manner, taking into account the location of existing underground and above-ground structures when using them [6].
- It was found appropriate to recommend a collector system with dimensions of 2.5x2.5m, 3.0x3.0 m. and 6.0x6.0m as parameters of a collector system suitable for cities in the conditions of Uzbekistan.
- The collector system can be used in active cities such as Tashkent, and will make a significant contribution to the goal of bringing the engineering infrastructure of newly built cities and existing cities to a new level.

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