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REDUCING ROAD CONSTRUCTION COSTS THROUGH THE USE OF LOCAL MATERIALS

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ABSTRACT	KEYWORDS
This article analyzes the issues of reducing road construction costs through the use of local construction materials. The study examines the economic and environmental advantages of using local gravel, sand, limestone, crushed stone, and recycled asphalt materials. In addition, the paper discusses the reduction of transportation and logistics costs, the implementation of resource-saving technologies, and the improvement of pavement quality through innovative methods. The research results demonstrate that the use of local resources not only reduces the overall cost of road construction but also ensures environmental sustainability.	highways, local materials, asphalt concrete, economic efficiency, construction cost, recycled asphalt, environmental safety, resource saving, innovative technologies.

Introduction

ANNOTATSIYA

Mazkur maqolada avtomobil yo‘llari qurilishida mahalliy qurilish materiallaridan foydalanish orqali qurilish xarajatlarini kamaytirish masalalari tahlil qilingan. Tadqiqot davomida mahalliy shag‘al, qum, ohaktosh, maydalangan tosh hamda qayta ishlangan asfalt materiallarining iqtisodiy va ekologik samaradorligi o‘rganilgan. Shuningdek, transport-logistika xarajatlarini qisqartirish, resurs tejamkor texnologiyalarni joriy etish hamda innovatsion usullar yordamida yo‘l qoplamalari sifatini oshirish masalalari yoritilgan. Tadqiqot natijalari mahalliy resurslardan foydalanish yo‘l qurilishi tannarxini kamaytirish bilan bir qatorda ekologik barqarorlikni ta’minlashda muhim ahamiyatga ega ekanligini ko‘rsatadi.

Kalit so‘zlar: avtomobil yo‘llari, mahalliy materiallar, asfalt-beton, iqtisodiy samaradorlik, qurilish tannarxi, qayta ishlangan asfalt, ekologik xavfsizlik, resurs tejamkorligi, innovatsion texnologiyalar.

АННОТАЦИЯ

В данной статье рассматриваются вопросы снижения стоимости строительства автомобильных дорог за счёт использования местных строительных материалов. В ходе исследования изучены экономические и экологические преимущества применения местного щебня, песка, известняка, дроблёного камня и переработанного асфальта. Также освещены вопросы сокращения транспортно-логистических расходов, внедрения ресурсосберегающих технологий и повышения качества дорожных покрытий с использованием инновационных методов. Результаты исследования показывают, что использование местных ресурсов способствует не только снижению себестоимости дорожного строительства, но и обеспечению экологической устойчивости.

Ключевые слова: автомобильные дороги, местные материалы, асфальтобетон, экономическая эффективность, себестоимость строительства, переработанный асфальт, экологическая безопасность, ресурсосбережение, инновационные технологии.

T

oday, the development of transport infrastructure is considered one of the most important strategic directions of the global economy. In particular, highways play a significant role as one of the main factors ensuring a country's economic potential, logistics system, interregional trade relations, and population mobility. High-quality and modern highways not only improve traffic safety but also help reduce transportation costs, shorten delivery times, and increase economic efficiency [1].

At present, many countries around the world are actively expanding and modernizing their road networks. However, several problems are observed in the road construction process, including the high cost of construction materials, increasing logistics expenses, high energy consumption, and dependence on imported materials. In particular, transporting construction materials over long distances requires substantial financial expenditures. This significantly affects the overall cost of road construction projects. In recent years, the need to introduce cost-effective and environmentally safe technologies in the road construction sector has been increasing. From this perspective, the efficient use of local construction materials has gained urgent scientific and practical importance. The natural resources available within our republic — gravel, sand, limestone, crushed stone, clay, cement raw materials, and recycled asphalt materials — have broad potential for application in road construction [2].

The use of local materials provides several economic and technological advantages. First of all, the transportation distance for construction materials is reduced, leading to lower transport costs. As a result, the overall cost of road construction decreases. In addition, the use of local resources accelerates construction work, prevents interruptions in material supply, and ensures continuity in the construction process.

The use of local materials in road construction is also environmentally significant. Transporting materials over long distances results in large emissions of carbon dioxide and other harmful gases into the atmosphere. The use of local resources reduces transportation activities and minimizes negative environmental impacts. At the same time, the use of recycled asphalt and construction waste contributes to reducing environmental problems. Today, developed countries pay great attention to improving road construction technologies based on the principles of the "green economy." In

particular, energy-saving technologies, the use of recycled materials, and construction based on local raw materials are becoming one of the main directions in the road construction sector. This approach ensures not only economic efficiency but also environmental sustainability [3].

In the Republic of Uzbekistan, large-scale reforms are also being implemented to develop transport infrastructure. Reconstruction of international highways, construction of new highways, and repair of existing roads are being carried out consistently throughout the country. In these processes, reducing construction costs and rational use of local resources are considered among the most important tasks. Different regions of the republic possess large reserves of natural materials suitable for road construction. Mountainous areas contain highly durable crushed stone and gravel deposits, while desert regions are rich in sand and mineral raw materials. Effective utilization of these resources reduces the need for imported materials and positively impacts national economic development.

Furthermore, modern innovative technologies are expanding opportunities to improve the physical and mechanical properties of local materials. Through the use of polymer additives, stabilizers, and geosynthetic materials, it is possible to enhance the strength and эксплуатацион properties of local raw materials. As a result, roads constructed using local materials have longer service lives and lower maintenance costs.

The main purpose of this article is to analyze the economic, technological, and environmental efficiency of using local materials in highway construction. During the research, the impact of local resources on road construction costs, their importance in reducing transportation expenses, and their compatibility with innovative technologies are scientifically examined. In addition, the prospects for the use of recycled materials are analyzed. The scientific novelty of the article lies in the comprehensive assessment of the economic efficiency of using local construction materials and the practical advantages of applying resource-saving technologies in road construction. The research results contribute to reducing costs in the construction and reconstruction of highways and improving the quality of road pavements.

RESEARCH METHODOLOGY

Theoretical Foundations of Using Local Materials

Construction materials used in highway construction are considered one of the main factors that ensure the strength, durability, and resistance of road pavements to transportation loads. Modern road construction widely utilizes asphalt concrete, cement concrete, gravel, sand, crushed stone, bitumen, and various stabilizers. Since a significant portion of these materials is transported from distant regions, the overall construction cost increases considerably. The theoretical basis for using local materials is founded on the principles of “resource efficiency” and “economic effectiveness [4].” This approach aims to reduce costs by utilizing natural and recycled resources available near construction sites. In this process, the physical and mechanical properties of materials, transportation distance, climatic conditions, and operational loads are taken into account. The main theoretical principles of using local materials include: reducing transportation and logistics costs; efficient utilization of local economic resources;

ensuring environmental sustainability; reducing energy consumption; ensuring continuity of the construction process; decreasing dependence on imported materials.

In global practice, the use of local resources in road construction is considered an important component of the "sustainable infrastructure" concept. Developed countries pay significant attention to the use of recycled asphalt, industrial waste, and natural local resources in road construction projects.

Types of Local Materials Used in Road Construction Gravel and Crushed Stone Materials. Gravel and crushed stone are among the most widely used materials in road construction. These materials are applied in forming the base layer of roads, drainage systems, and asphalt-concrete mixtures. Crushed granite and basalt stones extracted from mountainous regions possess high strength and are highly effective for highways used by heavy-duty vehicles. The main advantages of gravel materials are: high strength;

frost resistance; long service life; water permeability; affordability and availability.

The use of local gravel materials can reduce construction costs by up to 10–20%.

Fig1. Graphical analysis of the use of local materials

Sand Materials. Sand is used in road construction for cement-concrete mixtures, drainage layers, and asphalt production. Utilizing sand resources available in desert regions significantly reduces transportation expenses. In recent years, technologies for strengthening sand with special stabilizers have been developing rapidly. This makes it possible to create strong road foundations even in sandy regions. Advantages of sand materials include: abundant natural reserves; low cost; ease of processing; low transportation expenses.

Limestone-based materials are important raw materials for strengthening road foundations and producing cement. The regions of our republic possess sufficient limestone reserves, and their effective use reduces the need for imported cement materials. Mineral powders increase the density of asphalt-concrete mixtures and improve pavement resistance to deformation. Modern road construction widely applies the recycling of old asphalt pavements. In this technology, the old asphalt layer is milled,

crushed, and added to new asphalt mixtures. Advantages of recycled asphalt materials include: reducing the consumption of new bitumen; conserving natural resources; decreasing the volume of waste; improving economic efficiency. According to research findings, RAP technology can reduce asphalt production costs by 20–30%.

Concrete fragments, crushed bricks, and other construction waste materials can be used for temporary roads and base layers. This method: reduces waste generation;

decreases environmental damage; conserves natural resources.

CONCLUSION AND RECOMMENDATIONS

This study comprehensively analyzed the economic, technological, and environmental efficiency of using local construction materials in highway construction. The results of the research show that the use of local gravel, sand, limestone, crushed stone, and recycled asphalt materials significantly contributes to reducing construction costs. In particular, the reduction of transportation and logistics expenses is a key factor in lowering the overall project cost.

Today, highway construction is considered a complex process that requires large amounts of financial resources, energy, and technical equipment. The high cost of imported construction materials, the necessity of transporting them over long distances, and existing logistical challenges all contribute to the increase in overall road construction costs. Therefore, the efficient use of local materials is seen as one of the most economically viable solutions.

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