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СОВЕРШЕНСТВОВАНИЕ СОВРЕМЕННЫХ ТЕХНОЛОГИЙ И МЕТОДОВ ОРГАНИЗАТСИИ СТРОИТЕЛСТВА АВТОМОБИЛНЫХ ДОРОГ

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Annotatsiya. В стате рассмотрены современные технологии строителства автомобилных дорог, эффективные методы организатсии строителных протсессов и основные направления научно-технического прогресса в данной сфере. Проанализированы вопросы применения местных материалов и промышленных отходов, совершенствования конструксий дорожных одежд, комплексной механизатсии и автоматизатсии строителных работ. Освещены преимущества поточного метода организатсии дорожного строителства и перспективы внедрения робототехнических технологий.

Ключевые слова: *автомобилные дороги, дорожное строителство, механизатсия, автоматизатция, дорожная одежда, поточное строителство, робототехника.*

IMPROVEMENT OF MODERN TECHNOLOGIES AND METHODS OF ROAD CONSTRUCTION ORGANIZATION

Abstract. This article analyzes modern technologies in highway construction, effective methods of construction management and the main directions of scientific and technological development in the industry. The issues of using local materials and industrial waste, improving pavement structures, comprehensive mechanization and automation of construction processes are considered. The advantages of flow-line construction methods and prospects for the introduction of robotic technologies in road construction are also highlighted.

Keywords: *highways, road construction, mechanization, automation, pavement structure, flow construction, robotics.*

Introduction. Highways are one of the main elements of transport infrastructure and play an important role in ensuring the sustainable development of the national economy and the mobility of the population. In recent years, the increase in the number of vehicles, the growth of traffic intensity, and the rising share of heavy-duty trucks have significantly increased the requirements for highway infrastructure. In this regard, improving road construction technologies, enhancing the efficiency of construction processes, and extending the service life of road pavements have become urgent tasks.

Scientific research in the field of road construction is aimed at reducing material consumption, increasing the use of local resources, introducing energy-saving technologies, and automating construction processes. Today, the application of modern construction equipment, digital control systems, and robotic technologies plays a significant role in the development of the industry.

Research Materials and Methods. In this study, theoretical sources and currently applied technologies related to highway construction and construction management were analyzed. Construction materials, road-building technologies, mechanization, and automation processes were investigated. In addition, the organizational and economic efficiency of the flow construction method was evaluated.

Improvement of Highway Construction Technologies

In modern highway construction, a thorough study of the physical and mechanical properties of soils is of great importance. Based on the results of scientific research in geology, hydrogeology, and soil mechanics, opportunities for increasing the strength of roadbeds and controlling their water-thermal regime are expanding. The service life of road pavements largely depends on their structural design and operating conditions. Therefore, improving the methods for designing and calculating multilayer pavement structures is essential. By studying the behavior of rigid and flexible pavements under traffic loads, more durable pavement structures are being developed. The effective use of local mineral

materials, rocks, and industrial waste products in construction helps reduce construction costs. At the same time, the application of bitumen, emulsions, polymer-modified binders, and new-generation cements ensures the long-term durability of road pavements.

Mechanization and Automation of Construction Processes

Mechanization is one of the main factors in increasing labor productivity in road construction. Modern construction machinery possesses high performance and enables construction work to be carried out quickly and efficiently.

Comprehensive mechanization involves performing all major and auxiliary operations through a coordinated system of machines. This approach helps shorten construction periods and maintain consistent work quality.

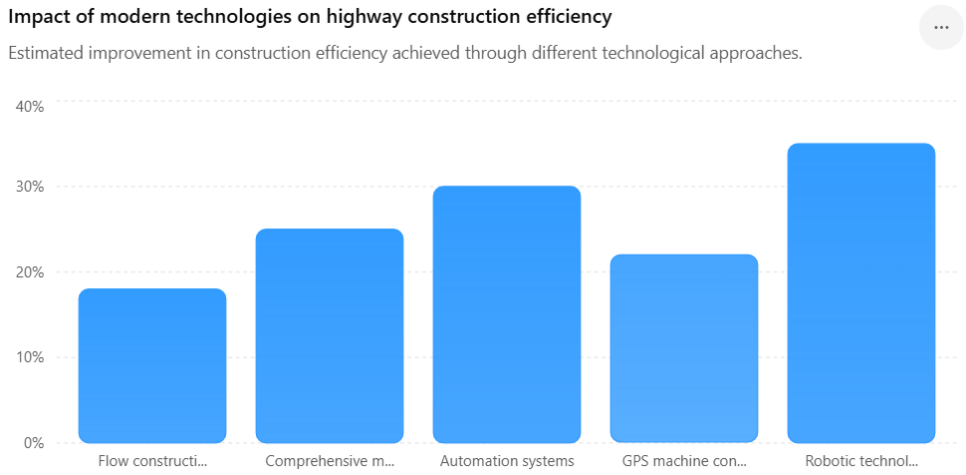

Figure 1 shows the estimated efficiency gains achieved through the implementation of modern technologies in highway construction. The results indicate that robotic technologies provide the highest improvement in construction efficiency (35%), followed by automation systems (30%) and comprehensive mechanization (25%). The flow construction method and GPS-based machine control systems also contribute significantly to reducing construction time and improving resource utilization. These findings demonstrate the importance of integrating advanced digital and automated technologies into modern highway construction projects.

Automation represents a higher stage of mechanization, allowing technological processes to be managed with minimal human intervention. Modern asphalt concrete plants, electronic control systems, and digital measuring devices contribute significantly to the efficient management of construction processes.

Importance of Robotic Technologies

In recent years, robotic technologies have been increasingly applied in the construction sector. Robotic systems help reduce the share of heavy and hazardous work, improve construction accuracy, and minimize the influence of human factors.

The use of drones for monitoring, automatic leveling systems, and GPS-controlled construction equipment in road construction significantly improves the efficiency of construction operations.

Flow Organization of Highway Construction

The application of the flow method in highway construction provides high economic efficiency. Under this method, construction teams operate in a predetermined technological sequence, performing work on specific sections of the road.

The main advantages of flow construction include:

Reduction of construction time;

Efficient utilization of labor resources;

Minimization of equipment idle time;

Ensuring stable product quality;

Reduction of construction costs.

The flow construction system consists of individual, specialized, and object-oriented flows. Their coordinated operation determines the overall efficiency of the construction process.

Conclusion. The application of modern technologies, comprehensive mechanization, and automation in highway construction significantly improves construction quality, labor productivity, and resource efficiency. The use of local

materials and innovative binders contributes to reducing construction costs and extending pavement service life.

The flow construction method ensures the effective utilization of labor, machinery, and materials while reducing construction time and minimizing equipment downtime. In addition, the integration of GIS, GNSS, BIM, and digital monitoring technologies enhances planning accuracy and construction management efficiency.

Table 1. Key Outcomes of Modern Highway Construction Technologies

Technology / Approach	**Main Benefit**	**Expected Impact**
Comprehensive Mechanization	Increased labor productivity	Faster construction operations
Automation Systems	Reduced human intervention and errors	Improved construction quality
Local Construction Materials	Lower material transportation costs	Reduced project cost
Innovative Binders	Enhanced pavement durability	Extended service life of pavements

Future development of the highway construction sector will largely depend on the wider adoption of robotics, artificial intelligence, and intelligent control systems, which will support the creation of more sustainable, durable, and cost-effective road infrastructure.

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