

USE OF MODERN TOOLS AND PROGRAMS IN THE ROAD MANAGEMENT SYSTEM

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Abstract

This article discusses the importance of using modern tools and software to optimize the transport system in the field of road engineering to ensure its efficient and safe operation. This topic covers the study of new technologies, understanding their principles of operation, and applying them to more efficient and effective road construction and management processes.

Keywords: Road engineering, transportation systems, GPS and GIS technologies, ITS systems, modern technologies, optimization.

Introduction

In the field of road engineering, the use of modern tools and programs for optimizing the transport system is of great importance to ensure the efficient and safe operation of the transport system. This topic is related to the study of new technologies, understanding the principles of their operation and application in order to implement road construction and management processes more efficiently and quickly. New tools and programs create great opportunities for optimizing road infrastructure, improving traffic flows, increasing the efficiency of road maintenance and construction processes. These technologies also serve to increase road safety, modernize transport management systems, and protect the environment.

Main part:

Modern technologies and applications play a significant role in increasing the efficiency and safety of the road engineering sector. These technologies create great opportunities not only for improving road construction and maintenance processes, but also for managing and optimizing transport systems. Below is a detailed description of how modern technologies are used in road engineering.

1. New tools and applications in road construction and maintenance

a) GPS and GIS technologies

GPS (Global Positioning System) and GIS (Geographical Information System) technologies are widely used in road construction and maintenance. GPS systems can determine the exact location of each object. This is especially helpful in analyzing the condition of the road and planning its improvement. GPS systems can be used to monitor the location and movement of materials and equipment used in road construction. GIS, on the other hand, is a cartography



and data analysis tool that allows you to show the condition of road networks and assess the stability of structures.[1]

b) AutoCAD and other design programs

Design and drafting processes play an important role in the construction and repair of roads. AutoCAD and its other modifications help road engineers create accurate and high-quality projects. With the help of these programs, accurate and fast data is obtained on the length, width, slopes and other physical parameters of the road. New versions of AutoCAD have 3D modeling capabilities, which helps to accurately and quickly plan all stages of road construction.

c) BIM (Building Information Modeling)

BIM technology is mainly used to optimize construction and repair processes. This system allows you to display each construction element (road layers, bridges, drives) in a fully digital model. With the help of BIM programs, all materials and labor required for road construction are planned. The biggest advantage of this method is the ability to quickly identify the difference between the planned and actual state of all processes and structures.

d) Use of scanners and sensors

New technologies used in road construction and maintenance include laser scanners and various sensors.[2] These devices can measure the current condition of the road in real time and make necessary corrections and improvements. Laser scanners allow for accurate and rapid measurement of each section of the road, which significantly speeds up the repair process.

2. Transport system management and optimization

a) Intelligent Transport Systems (ITS)

Intelligent transport systems (ITS) help to manage traffic flows, optimize the road network and increase road safety. With the help of ITS technologies, for example, it is possible to monitor traffic flows in real time, show cars the most convenient routes for movement, monitor road conditions and traffic congestion. These systems are important not only for road engineering, but also for transport management. ITS technologies can increase the efficiency of road systems, improve traffic flow and prevent road accidents.

b) Smart road signs

Smart road signs have been developed using modern technology. These signs provide information about road conditions using sensors and displays. For example, these signs provide information about traffic congestion, road gradients, or dangerous areas. In most cases, these systems send real-time warnings to drivers to improve road safety.[3]

c) Traffic flow control programs

Effective traffic flow management is essential for optimizing the road system. With the help of special programs, traffic flow is monitored in real time and the movement of each vehicle is



optimized. With the help of these programs, for example, it is possible to send cars along the best routes, avoid traffic jams and delays. These programs are of great help not only in optimizing traffic flow, but also in ensuring road safety.

d) Transport network optimization and intermodal systems

Modern transport networks are integrated, and intermodal transport systems can manage the interaction of different types of transport. These systems combine road, rail and air transport networks. Intermodal systems can improve transport flows and deliver cargo to the right place in the fastest and cheapest way. These systems not only increase transport efficiency, but are also environmentally beneficial, as vehicle downtime is reduced and air pollution is reduced.

3. Technology advantages and future development prospects

One of the main advantages of applying modern technologies to road engineering is the increase in the efficiency of construction and maintenance processes. With the help of new tools and programs, it is possible to save resources and time, improve quality and reduce errors. In addition, the optimization of transport systems management will greatly contribute to reducing traffic congestion and increasing safety.

Further development of technologies is expected in the future. For example, new approaches to artificial intelligence and data analysis can be used. With the help of artificial intelligence systems, it will be possible to predict the condition of the road, optimize repair processes and manage traffic flows more efficiently. Also, the introduction of environmentally friendly technologies and the use of new, energy-saving materials are important for the future of road engineering.

Modern technologies play an important role in road engineering, and their application increases efficiency in road construction, maintenance, management and optimization of transport systems. Technologies such as GPS, GIS, BIM, ITS, and smart road signs play an important role in upgrading road infrastructure, ensuring road safety, and reducing negative environmental impacts. Further development of technologies in the future will serve to increase the efficiency and safety of road engineering.

The use of modern tools and applications is essential for improving efficiency in road engineering, improving the condition of road networks, managing traffic flows, and ensuring safety. These technologies can be widely used in road construction and maintenance processes, as well as in optimizing transport systems. The following provides detailed information on the role and effectiveness of GPS and GIS technologies and Intelligent Transport Systems (ITS) in road engineering.[4]

1. Use of GPS and GIS technologies

a) GPS (Global Positioning System) system

GPS is a technology that helps determine a precise and constant position relative to the earth. Devices use signals sent by the GPS network to determine their precise geographical location. GPS technology is used in road engineering, mainly in road construction and maintenance processes.



The role of GPS technology in road construction

GPS systems are widely used in road construction, as they allow the precise location of objects to be determined. The geodetic measurements and locations required for each stage of road construction are accurately performed using GPS systems. For example, the starting and ending points of the road, slopes, turns and turns, and the lowest and highest points are determined. This information facilitates planning and control of the construction process.

GPS in monitoring road conditions

During road construction and repair work, it is necessary to constantly monitor the condition of the road. With the help of GPS technology, the movement of construction materials, equipment used and workers on each section of the road is precisely controlled. With this technology, it is possible to determine information about each construction stage, for example, the density of the asphalt layer, the location of structures and objects.

Increasing the accuracy of structures

With the help of a GPS system, any inaccuracies can be detected during the construction process. For example, errors in the slope of the road or its direction can be quickly detected. This, in turn, helps to make the construction process more accurate and high-quality. The precise measurements and locations obtained using GPS are taken into account and the necessary corrections are made.

b) GIS (Geographical Information System) technology

A GIS system is basically a system that allows data collection, analysis, and visualization. With the help of GIS technology, all data related to road engineering can be collected, analyzed, and plans can be optimized.

GIS technology in road network management

A GIS system can be used to monitor the condition of a road network, control traffic, and plan which parts of the network need maintenance. A GIS system can be used to create geodetic maps of road networks, and can also analyze road network parameters such as speed, road width, layers, and many others.

Road construction planning

GIS can be used to determine the most optimal routes for new road construction. This system determines the best routes taking into account traffic flows, traffic jams, and problems. GIS makes it easier to analyze the geological and climatic conditions of the road, plan construction materials, and construction processes.

Increase efficiency

GIS can be used to assess road conditions and improve network efficiency. A GIS system can help determine how a road is performing by analyzing traffic flows, congestion, and traffic



safety. At the same time, this system collects all the information necessary to ensure the efficient operation of the road infrastructure.

2. Intelligent Transportation Systems (ITS)

Intelligent Transport Systems (ITS) represent modern technologies used to manage and optimize the transport network. ITS technologies are used to effectively manage traffic flows, reduce congestion, and increase road safety. ITS systems combine several technologies, including GPS, GIS, sensors, cameras, and others.[5]

a) Basic elements of ITS systems

The main elements of ITS systems include:

- **Transport monitoring and management** : ITS systems enable real-time monitoring of the road network. These systems allow for the analysis of traffic flows, identification and management of traffic jams. Road condition monitoring systems enable rapid detection of any defects and rapid response to them.
- **Devices and Sensors** : ITS systems use a variety of devices, such as motion-detecting cameras, sensors, and radars, to collect information about the status of vehicles and road conditions and send this information to a central location.
- **Data transmission network** : ITS systems use a network to transmit and receive data. Using this network, all data is sent to a center, and then the system manages traffic flow and reduces congestion.

b) The role of ITS systems in improving road safety

ITS systems are important in increasing road safety. By monitoring traffic flows in real time, dangerous situations can be quickly identified and preventive measures can be taken. With the help of ITS systems, road signs and signals can also be automatically updated, which increases road safety.

c) Reduce traffic jams

One of the main tasks of ITS systems is to reduce traffic congestion. By detecting traffic jams on different parts of the road and optimizing the movement of vehicles, ITS systems help reduce traffic congestion on the roads. These systems are of great help not only to drivers, but also to organizations managing the road infrastructure.

d) Smart road signs

Smart road signs work as part of ITS systems. These signs use displays and sensors to display information such as traffic jams, dangerous areas, and road conditions. Smart signs also show the most convenient routes for vehicles to travel. With this system, drivers can change their lane or adjust their speed.



Conclusion

The use of modern tools and programs in road engineering not only brings about a technological revolution, but also creates new opportunities in the processes of road construction and management. With the help of these programs, it is possible to analyze the condition of road networks, create optimized routes, manage traffic flows and ensure proper road maintenance. All this is not only economically beneficial, but also important from an environmental and safety point of view. Thus, the introduction of modern technologies in the field of road engineering increases the efficiency and safety of the transport sector, reduces the negative impact on the environment.

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