COMPREHENSIVE RESEARCH OF AUTOMOBILE ROAD: METHODOLOGY, STAGES, AND TOOLS

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Abstract: This article is a structured guide for conducting comprehensive road research. We will consider key stages: from preliminary analysis and data collection to assessing safety, transport quality, economic efficiency, and environmental impact. The methodology applies to scientific research, design documentation, the audit of existing routes, and the planning of repair work.

Key words: road research, methodology, design stages, digital tools, GIS, CAD, road safety, infrastructure sustainability.

Introduction

Any research begins with defining the goals. For a highway, they can be [1]:

- Assessment of the current state: Determining the degree of wear of road surfaces, roadsides, and engineering structures.

- Safety analysis: Identifying hazardous areas and causes of accidents.

- Assessment of capacity and service level: Determining road congestion and traffic comfort.

- Economic analysis: Calculation of national economic efficiency, maintenance cost, and return on investment.

- Environmental assessment: A study of road impact on the environment.

- Reconstruction or repair planning: Justification of project solutions.

2. Stages of research [2]

Stage 1: Preparatory work and collection of initial data

Chamber works [3]:

o Study of project documentation: Construction history, previous repairs, technical solutions.

o Analysis of cartographic materials: Topographic maps, satellite images, GPS data [4].

o   Statistics collection: Data on accidents over the past 3-5 years from the Road Patrol Service, traffic intensity (constant and daily traffic), traffic flow composition (passenger cars/trucks).

Stage 2: Field surveys and instrumental measurements [5].

This is the most important and labor-intensive stage.

2.1. Assessment of the transport and operational state [6]:

   Geometric parameters:

o   Longitudinal profile: Measuring the slopes and radii of vertical curves.

o   Route plan: Horizontal curve radii, transition curve length, presence of turns [7].

o   Transverse profile: Width of the roadway, roadsides, number of lanes, transverse slope.

o   Tools: Tacheometers, high-precision GPS equipment, laser scanners, unmanned aerial vehicles for aerial photography.

o   Road surface and pavement condition [8]:

o   Uniformity: Measurement using profilographs or profilographs. It is assessed using the international IRI (International Roughness Index).

o   Clutch qualities: Measuring the clutch coefficient using brake carts or side force instruments. Direct safety assessment.

o   Surface integrity: Visual inspection and fixation of defects: cracks, holes, tracks, floats. Photo and video recording methods are used.

o   Strength: A calculation method based on data from road pavement design and test results.

2.2. Assessment of road safety [9]:

•   Analysis of accidents: "Binding" traffic accidents to kilometers and road stations, identifying local accident foci.

•   Assessment of the accident rate: Comparing the actual number of accidents with the normative number for this class of roads.

•   Instrumental Safety Audit (Road Safety Audit): Sequential inspection of roads for compliance with passive safety principles:

•   Assessment of the situation: Visibility, lighting, readability of road signs and markings.

•   Analysis of intersections and joints: Geometry, movement organization, visibility.

- Condition of roadsides: Availability and width of reinforcement strips, exit safety.

- Assessment of road structures: Condition of bridges, overpasses, tunnels.

2.3. Assessment of traffic conditions [10]:

o Measuring traffic intensity: Automatic counters, video cameras with transport detection.

o Determining the composition of the transport flow: The share of passenger and freight transport.

o Calculation of movement speed: Average speed, free movement speed, 85th percentile speed.

o Assessment of capacity and service level (LOS): Using HCM (Highway Capacity Manual) methods or domestic analogues.

2.4. Inspection of the arrangement and elements of the road environment [11]:

- Road signs: Compliance with standards, presence, readability, placement.

- Road markings: Availability, wear, brightness coefficient (visibility at night).

- Enclosures and lighting: Type, condition, compliance with requirements.

- Means of organizing pedestrian traffic: Sidewalks, pedestrian fences, crossings.

Stage 3: Laboratory studies (if necessary)

- Selection of asphalt concrete cores for strength, density, and grain composition testing.

- Analysis of the earthworks.

- Stage 4: Desk data processing and analysis

- Data systematization: Consolidation of all received data into a unified geoinformation system (GIS) or database, where information is linked to kilometers and road stations.

- Calculation work:

- Determination of comprehensive condition indicators (e.g., PCI - Pavement Condition Index).

- Forecasting the remaining service life of road surfaces.

- Modeling transport flows to assess the effectiveness of future changes.

- Calculation of economic indicators (payback period, net discounted income).

Stage 5: Formation of conclusions and recommendations

This is the summary of the entire study. Conclusions should be specific, measurable, and tied to road sections.

Example of conclusion: "In the section km 15+500 - km 16+200, critical wear of the pavement is observed (IRI = 6.5 m/km, tracks up to 25 mm), which is the reason for low adhesion coefficient (0.35) and high accident rate (five accidents per year)."

Example of recommendation: "It is recommended to carry out major repairs of the road surface on the specified section using gravel-mastic asphalt concrete. Set the 3.24 "Maximum Speed Limit" sign up to 70 km/h for the duration of the work.

3. Tools and technologies

- Geodetic equipment: Tacheometers, GPS receivers.

- Specialized automobile laboratories: Equipped with complexes for measuring evenness, adhesion, geometry.

- Unmanned aerial vehicles (UAVs): For the rapid creation of orthophotoplans, 3D models, and digital terrain models.

- Mobile video recording systems: For recording road conditions.

- GIS technologies (ArcGIS, QGIS): For storing, visualizing, and analyzing spatial data.

- Specialized software: For calculating throughput capacity (PTV Vissim, TransCAD), analyzing traffic accident data.

Conclusion

Comprehensive road research is not just a set of measurements, but a systematic analysis that connects technical condition, safety, economy, and ecology. The result of such research is an objective and complete picture, which serves as a reliable basis for making management decisions on the development, maintenance, and repair of road infrastructure, ultimately leading to increased safety, comfort, and economic efficiency of road transportation.

REFERENCES:
1. KMK 2.01.15-97. Regulation on Technical Inspection of Residential Buildings. - T: 1997, - 125 p.

2. Aronov R.I. Testing of Structures: Textbook for Universities.- M. Higher School.1974.- 187 p.

3. Popov K.N., Shmurnov I.K. Physical and mechanical tests of building materials. - M.: Higher School, 1989, - 239 p.

4. Greenberg V.E., Semetov V.G., Shoikhet G. B. Control and assessment of the state of load-bearing structures of buildings and structures during the period of operation.-L.:Stroyizdat,1982.-19p.

5. Ulkanov S., Gulomov F. 3 steps to transport dangerous goods in Uzbekistan //Science and Education. – 2022. – Т. 3. – №. 1. – С. 133-136.

6. D.E. Dolidze. Testing of structures and installations. M., Higher School, 1975.

7. Sodiqjon o'g'li U. S. ZAMONAVIY METODIKA VA DIDAKTIKANING RIVOJLANISHIDA ZAMONAVIY O 'QUV-DIDAKTIK VOSITALARINING AHAMIYAT //AndMI Xalqaro ilmiy-amaliy konferensiyalari. – 2024. – Т. 1. – №. 1. – С. 146-148.

8. Mahammadovich, A. A., and Dilshatbekovich, K. A. (2023). INNOVATION CONSTRUCTION MATERIALS "POLISTROBLOK." *Conferencea*, 66-69.

9. Sodiqjon o'g'li U. S. Kredit-modul tizimi asosida ta'lim vositalarining klassifkatsiyasi yaratish //4-SHO 'BA MATERIALLARI МАТЕРИАЛЫ 4-СЕКЦИИ SECTION 4 MATERIALS. – 2022.

10. Menaka G. et al. Deep Reinforcement Learning for Self-Healing Communication Networks: Addressing Node Failure and QoS Degradation in Dynamic Topologies //National Journal of Antennas and Propagation. – 2025. – Т. 7. – №. 2. – С. 133-144.

11. Улканов С. и др. СОВРЕМЕННЫЙ АВТОМОБИЛЕЙ ОХЛАЖДЕНИЕ СИСТЕМА РАБОТА ОСОБЕННОСТИ //Science and innovation in the education system. – 2022. – Т. 1. – №. 6. – С. 23-30.