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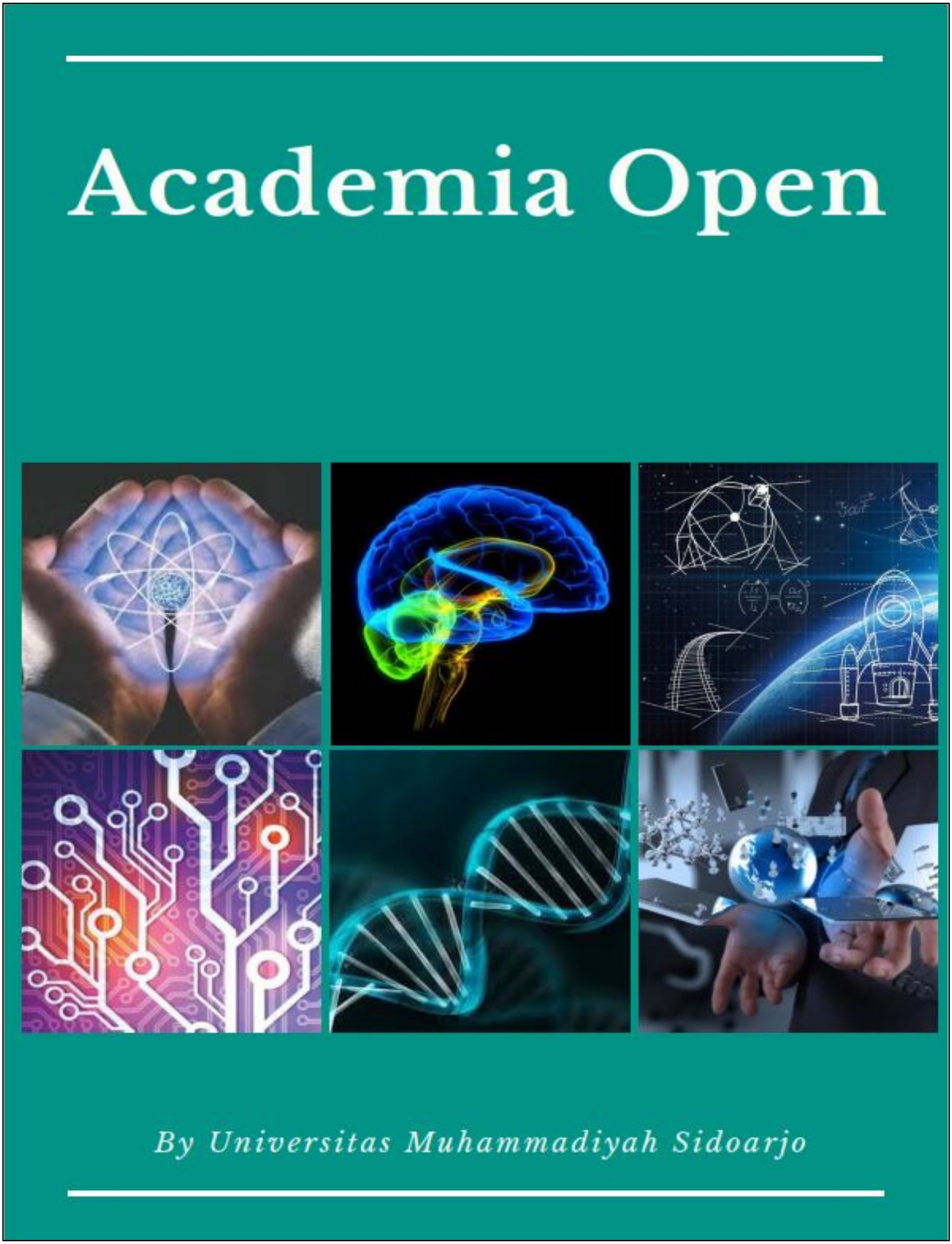

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Maintenance of Cement Concrete Pavements: Defects and Their Elimination

Pemeliharaan Perkerasan Beton Semen: Cacat dan Penghapusannya

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Abstract

The main purpose of this article is to analyze the operational condition of existing cement-concrete roads in the Republic of Uzbekistan and identify work to eliminate existing problems. According to this, defects in cement concrete pavements, using the method of visual examination of the condition proposed by British specialists, are the objects of study of the section of the A-380 "Guzor-Bukhara-Nukus-Beynov" highway (480-490 km) and section of the M-39 "Almaty-Bishkek-Tashkent-Shakhrisabz-Termiz" highway (1173-1184 km). Based on the results, coating surface defects and structural defects were classified, and the causes and consequences of their occurrence were analyzed. The importance of improving storage technologies in eliminating problems caused by defects in cement concrete pavements is emphasized, and through this, issues of increasing the service life of coatings are considered. At the same time, recommendations were made on continuous monitoring of the condition of the roads in use, organization, and planning of operational works based on the results of the study of the pavement condition.

Highlights:

1. Analysis of Road Conditions: Evaluating defects in Uzbekistan's cement-concrete highways.
2. Causes and Solutions: Identifying defects, their causes, and solutions for longevity.
3. Recommendations: Continuous monitoring, improved storage, and operational planning for

Keywords - cement concrete, service life, surface defects, structural defects, Visual condition surveys (VCS).

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Introduction

Today, a number of reforms are being carried out in our Republic to carry out the construction of highways with high strength and the most efficient use of existing local raw materials in order to increase the service life of highways. Therefore, the demand for cement concrete with high strength and a long service life period is increasing [2]. In accordance with the decree of the president of the Republic of Uzbekistan No. 249 dated may 18, 2022 “On measures to expand the network of cement concrete highways”, work is being carried out to gradually transfer internal roads to cement concrete roads, as well as universal roads in the network of highways [10]. In the year 2022, when one passed, it can be evidence of our opinion that almost 500 km of internal roads were transferred to cement concrete.

It should be noted that, in particular, the research facilities on the cement concrete commissioned in our Republic, the part of the A-380 “Guzor-Bukhara-Nukus-Beynov” Highway (480-490 km) and the part of the M-39 “Almaty-Bishkek-Tashkent-Shakhrisabz-Termez“ Highway (1173-1184 km) have its negative impact on ensuring that the roads serve for the specified periods of time. This makes it necessary to thoroughly analyze the problems occurring in the natural-climatic and operational conditions inherent in our Republic and improve repair and storage technologies to eliminate defects [3].

Bibliography

Cement concrete works in a complex state of strain under the influence of repeated dynamic loads and variable temperature and humidity that fall from vehicles [5]. It is assumed that the cement concretes will be in constant care after commissioning. Because, an increase in cargo and passenger volume and a change in natural climatic conditions will lead to a deterioration in the coating and will cause an increase in economic costs if the work goes to the level of repair [6,7]. American and English researchers have researched the deterioration of the coating condition during the service life depends on their maintenance. The study was conducted in the style of visual condition surveys. According to analyzes, this method provides the most useful information on determining the causes of defects occurring in the coating and allows you to choose the appropriate measures to eliminate them [3].

Methods

Visual condition surveys (VCS) will provide the most useful information in determining the causes of defects and deciding on the appropriate treatment. VCS are used to:

• record features and defects;

• determine any need for further investigations;

• provide an inspection record for future reference; and,

• allow the appropriateness and success of any treatment to be evaluated.

Research in this method is based on the analysis of defects by walking to determine the intensity and speed of movement on an existing highway and monitor the condition of the coating.

Typically, the appropriate VCS method is dependent upon the:

• findings from previous investigations;

• scheme stage (i.e. options assessment, preliminary design, or detailed design);

• type and severity of defects; and,

• proposed maintenance activities.

Result and Discussion

In addition to the fact that defects in cement concretes occur under the influence of loads and climatic conditions from vehicles, they also occur as a result of defects in the coating design process and a violation of the construction technology [9]. Defect refers to imperfection or deficiency. Defects in road coverings are said to be a condition that negatively affects the structural condition or appearance of its operation.

Defects in cement concretes according to the proposal of English researchers are classified as follows:

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•Surface defects are present only within the upper third of the slab thickness.

•Structural defects are present at a depth and / or extend greater than one third slab thickness including the pavement foundation.

Objects of research according to the results of visual State studies carried out on the part of the A-380 Highway "Guzor-Bukhara-Nukus-Beynov" (480-490 km) and the section of the M-39 Highway "Almaty-Bishkek-Tashkent-Shakhrisabz-Termez" (1173-1184 km), some types of defects of both types were observed in the coating. Below we will get acquainted with the defects that fall into both types according to the classification.

Defects on the pavement surface include: surface irregularities; surface scaling; crazing; pop-outs; defective joint seals; and, shallow joint spalls.

The above defects are found in highway covers that have been put into operation. We will analyze the reasons for their origin by studying the characteristics of them one by one.

Surface irregularities is the nonevenness of the surface. It occurs mainly as a result of pits, bumps, breakdowns in the seams that occurred during the years of use (Figure 1).

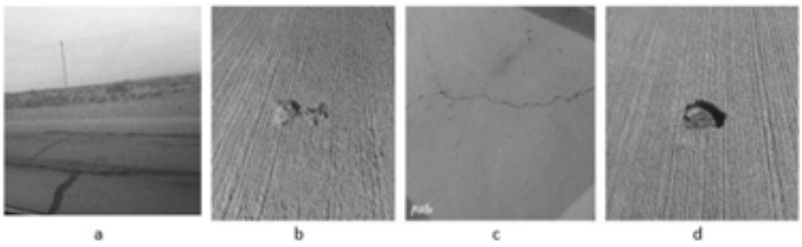

Figure 1. *Pavement defects*: a) Surface irregularities; b) Surface scaling; c) Crazing; d) Pop-outs [11].*

In order to avoid such defects in the coating, it will be necessary to eliminate defects in the conduct of repair work. That is, when carrying out repairs, it is necessary to reduce the impact of work on the violation of the coating surface.

Surface scaling is mainly caused by the influence of freezing melting periods (Fig. 1). That is, the expansions that occur when water turns into ice result in shallow cracks. Although attempts are made to prevent ice formation, the use of chemical anti-freezing reagents can accelerate deterioration of the coating surface. Chloride salts, on the other and,cause a corrosive environment in concrete. In addition, carbonation due to natural weather is also a factor in absorption formation. Carbonation increases the porosity of the concrete, making the concrete more sensitive.

If these defects are on the surface of the coating can be eliminated by applying surface restoration technology. If they increase in thickness and depth, they will affect the safety of the road. Therefore, it is effective to use moisture and heat-repellent compositions in order to minimize the effects of external factors on the surface of the coating.

Crazing usually occur as a result of excessive moisture or improper drying during construction (Figure 1). In particular, when a weak layer of cement and fine aggregate particles are allowed to form, cracking can occur and concrete develops on the surface.

Crazing do not have a serious effect on movement, but require traction with constant monitoring of their condition. With increased crack width and depth, coating surface restoration technologies are recommended.

Pop-outs is often caused by the freezing-melting effect of aggregates in concrete (Figure 1). The volumetric expansion of frozen water can generate sufficient pressure which will cause the process of breaking the aggregate or separating the aggregate from the lime. As a result, migrations occur. These defects manifest themselves after periods of cold weather.

To eliminate such defects, filling the formed recesses using special glue or a mixture is carried out. In this, of course, one looks at the dimensions of the pits.

Defects in seam fillers have many disadvantages of traditional filling of compression seams with bitumen Mastic in cement concrete. In hot weather, when the width of the seam decreases, the Mastic protrudes over the surface of the coating and forms nodules. They are pressed and flattened by the wheels of the car. Not all Mastic in the expanded seam in cold weather will fall back into place [4]. The joint is full and filled with dirt (Figure 2). Therefore, during the operation of the road, it is required to periodically remove it from the surface of the coating and put a new Mastic after the top of the seam is cleaned of impurities. In addition mastics do not withstand much

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and completely lose their deformation properties in two to three years.

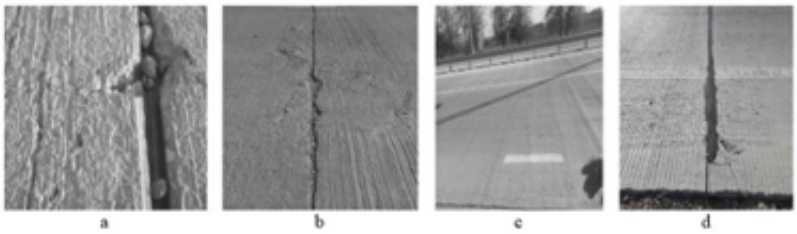

Figure 2. *Pavement defects* a) Defectiva joint seals; b) Shallow joint spalls; c) Longitudinal cracks; d) Fracture of the covering edges [11].*

Shallow joint spalls are mainly caused by the failure of the sutures, as a result of which various defects are observed in the sutures under the influence of climatic conditions and dynamic loads (Figure 2). The reasons for the failure of the seams are the failure of the seams to longitudinal and transverse compression due to the fact that timely storage work is not organized, that is, as a result of the Mastic in the seams and the leakage of rubber cords, dust and sand in the coating are filled with seams[1].

If the less deep breakdowns in the seams do not pose a major threat to the safety of movement, it will lead to a deterioration in the coating condition. That is, the penetration of water or other substances into the coating can reduce the strength and cause serious defects. For this reason, during the use, it is necessary to carry out a planned implementation of constant monitoring, maintenance and repair of the roadway.

Structural defects include transverse, longitudinal, diagonal cracks in the coating, breakage of the edges of the plate, sinks and polygons.

Cracks occur at the expense of increasing the coating temperature than allowed, changing the distance between the compression and expansion seams, increasing the force falling from the transport from the coating lifting capacity, placing the coating tension in places with weak connections with the base, poor-quality cutting of the deformation seams, improper installation of screw joints and insufficient bonding of the plate with the base (Figure 2).

When the cracks are located deep, they must be filled with special substances. Repair and hermetization of cracks up to 40 mm with intact edges includes the following steps: marking, sawing cracks, cleaning, spraying compressed air, spraying hot air in wet concretions, pouring rubber powder or pressing a compacting rope, processing crack walls with a primer, hermetizing[8].

It is necessary to carry out repairs using special materials, such as the type of repair of broken areas in cases where broken edges are damaged, and it is envisaged that a camera will be formed under the wax.

Breakage of the edges also occurs mainly due to the fact that the coatings are raised as a result of Polyhedra and are compressed with one, in addition, as a result of the movement of heavy-duty cars, stresses appear on the coating and also lead to a fracture of the coating edges and other areas of the coating.

Dives and landslides occur as a result of wetting the road foot grunt; the presence of polygonal grunts and deep freezing of the road foot.

The defects mentioned above can be seen in most sections along the length of the road. These defects occurred during the 5-year period of service of the road segments. Speaking with employees of the organization that serves road lanes, they mentioned that during the service period, mainly storage work is being carried out, their experience in the operation of cement concrete is insufficient, as well as the need for technologies and machine-mechanisms for repairing these coatings.

It is known that if defects in the coating are not eliminated in time, they have a direct effect on the strength of the coating. As a result of the regular high speed and the movement of heavy-duty cars, breakdowns occur in the coating. Therefore, it is necessary to study the causes of defects that have occurred and carry out operational work on time.

Conclusion

From the above analyzes on the operational status of highways with cement concrete in the Republic, the following conclusions arise:

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- today it is necessary to constantly monitor the state of roads with cement concrete on the Republic;

- in the work of the operation of highways with cement concrete, sufficient study is required in accordance with the full range of territorial conditions;

-as a result of the threats carried out, it is necessary to develop technologies for proper and cost-effective storage

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