ISSN 2195-1381 Volume- 3 April 2025
https://journal-index.org/index.php/ajasr

RESEARCH ON THE SERVICE LIFE OF ASPHALT CONCRETE PAVEMENT OF ROADS

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Abstract: *To ensure the performance of roads under various weather conditions, it is essential for builders to carefully select the composition of the asphalt concrete mixture and to give significant attention to climate conditions when laying and compacting the pavement.*

Keywords: *asphalt concrete, degradation, bitumen, cracks, porosity, subgrade, corrosion, natural environment, climatic conditions, pavement.*

Introduction:

As of January 1, 2021, the total length of roads in the Republic amounted to 184.8 thousand kilometers, including 42.9 thousand kilometers of public roads, 132 thousand kilometers of inter-farm roads, 24.8 thousand kilometers of departmental roads, and 9.9 thousand kilometers of urban streets. Of these, 77.9 thousand kilometers, or 42.2%, are in need of repair.

The reconstruction and repair of certain roads are often delayed from year to year and left incomplete. This prevents proper maintenance of these roads. For instance, instead of applying fine-grained dense asphalt concrete pavement, roads are often left with a coarse-grained porous asphalt concrete lower layer. In many cases, there is also a need to further improve the quality and condition of fine-grained dense asphalt concrete pavements.

Most concerning is that road traffic accidents are occurring in areas where road repairs are ongoing, left unfinished, or urgently needed.

Main Part

Asphalt concrete pavement is negatively affected by sunlight, high temperatures, wind, rain, snow, and days with rapid temperature fluctuations across 0°C. Long-term experience with such pavements shows that, in some cases, they do not reach their design lifespan. This is often due to insufficient study of deformations under the effects of dry, hot climatic conditions and the failure to account for local climatic factors.

Asphalt concrete pavement has a high susceptibility to deformation. Its service life exceeds 20–25 years when the traffic intensity is 1,000 vehicles per day. However, when traffic intensity exceeds 10,000 vehicles per day, the service life is reduced to 3–4 years.

The primary type of asphalt concrete pavement degradation, which determines its service life, is the wear and deformation caused by vehicle wheel impact. During vehicle movement, horizontal forces create shearing in the asphalt concrete, resulting in residual deformation in the pavement.

Deformation refers to the alteration and displacement of pavement particles' positions. The changes associated with deformation include modifications in size and shape, the loss of pavement integrity, and structural stability, all while the pavement's overall mass remains unchanged. Deformations are classified into elastic and residual (plastic) deformations.

The dimensions and types of deformation depend on the intensity and duration of exposure to high temperatures throughout the day and year. Under prolonged exposure to sunlight and high temperatures, the aging of bitumen accelerates, resulting in the loss of its elasticity. Consequently, this significantly impacts the long-term serviceability of asphalt concrete pavements.

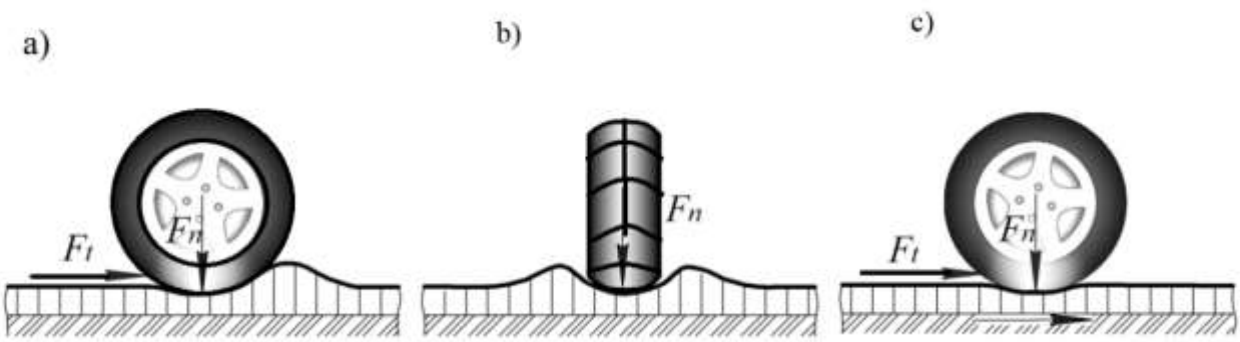

Figure 1. Deformation States of Road Surfaces Under the Influence of Normal Force F_n and Shear Force F_t from a Vehicle Wheel:

a) Formation of transverse waves at braking points.
b) Development of longitudinal ruts.
c) Longitudinal displacement of the pavement under the wheel.

Main Causes of Irregularities in Pavement

The primary reasons for the formation of irregularities in road pavement are as follows:

- High loads from vehicles.
- Use of substandard materials.
- Influence of climatic factors.
- Pavement wear.
- Deformation and damage to the pavement, along with the failure to address these defects in a timely manner.

Seasonal Effects on Asphalt Concrete Pavement

Autumn Season:

During autumn, rapid temperature transitions from high to below freezing induce tensile stresses in asphalt concrete. These temperature changes result in the formation of cracks in the pavement. Cracks reduce the deformation capacity of asphalt concrete. At 0°C, as ice melts, moisture penetrates the asphalt, creating internal stresses. This process, combined with temperature decreases and deformation, leads to crack formation.

Water on the pavement surface reduces surface energy and contributes to new surface formation due to deformation. Increased porosity accelerates air and water circulation, which, in turn, hastens physical and chemical changes in the bitumen under the influence of temperature, light, air, and water. For this reason, pavement deterioration is often observed in autumn.

Winter Season:

In winter, the performance of asphalt concrete pavement changes rapidly. The degree of cooling across the pavement thickness and temperature-induced deformation primarily depend on the thermal and physical properties of the pavement layers.

Thicker pavements with lower thermal conductivity maintain higher internal temperatures, resulting in reduced temperature stress. If the pavement is thick, cooling progresses slowly, allowing stresses at layer boundaries to dissipate. However, for thick pavements, rapid growth in temperature stress may occur at greater depths.

Conclusion

In summary, the performance of asphalt concrete pavement varies across seasons and under different conditions. Key factors influencing pavement durability include the load exerted by vehicles and the daily, weekly, monthly, and annual traffic intensity. Effective control of these factors is essential.

Additionally, great attention must be given to selecting the composition of the asphalt concrete mixture, laying it on the road, and compacting it, all while considering the specific climatic conditions. This approach ensures improved pavement longevity and reliability.

Refernces

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