RowanUniversity
CENTER FOR RESEARCH & EDUCATION IN
ADVANCED TRANSPORTATION ENGINEERING SYSTEMS

DEPARTMENT OF TRANSPORTATION
THE STATE OF NEW JERSEY

Technical Brief

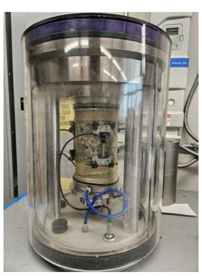
Evaluation of Permeable Porous Pavement for Heavy Traffic Loading and Validation of Design Framework Using Full-Scale Testing

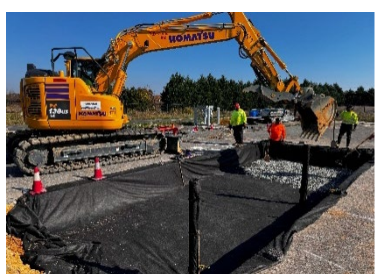
Background

Porous asphalt is a permeable pavement technology that allows surface water to infiltrate through the pavement structure into the underlying soil. It has been commonly used in parking lots, low-volume roads, shoulder lanes, walkways, and as quiet pavement in Europe, with design practices primarily focused on hydrological performance. However, comprehensive structural design guidelines for porous asphalt pavements under heavy traffic loading remain limited. Although the environmental benefits of this technology are well established, uncertainties regarding durability and load-bearing capacity restrict its application on heavily trafficked roads. Investigating the balance between permeability and structural performance is therefore essential to enable broader adoption of porous asphalt pavements and promote sustainable roadway infrastructure.

Research Objectives and Approach

The primary objective of this study was to develop and validate a design framework for porous asphalt pavements on high-traffic roadways using the AASHTO 93 and Pavement ME design methods through Accelerated Pavement Testing (APT). The mix design and performance tests such as Permeability, Draindown, Cantabro Durability and Tensile Strength Ratio were conducted to collect the Level 1 design inputs. Under the NJDOT Pavement Support Program with guidance from NJDOT's Pavement and Drainage Management and Technology Unit, the CREATES research team adopted an integrated laboratory-field approach to develop New Jersey-specific design and construction specifications, including mix design and performance testing, full-scale pavement construction, APT evaluation, and development of rutting prediction model coefficients.





Summary of Findings

Laboratory testing and analysis showed that porous asphalt mixtures exhibited APA rut depths below 5 mm while maintaining permeability above 2,000 ft/day. Compared to the unconfined dynamic modulus, the confined dynamic modulus increased by 16% for the Modified Open Graded Friction Course (MOGFC) and by 21% for the Asphalt Stabilized Drainage Course (ASDC), resulting in a 91% increase in pavement design life. Two APT sections were evaluated under traffic levels: 1 million and 13 million Equivalent Single Axle Loads (ESALs), corresponding to approximately 62,500 and 812,500 Heavy Vehicle Simulator (HVS) passes, respectively. The results showed that a thin MOGFC layer combined with a thicker ASDC layer, maintained rutting below the NJDOT threshold of 0.75 inches, with most rutting occurring during the first 10% of applied loading and without reducing permeability below the minimum threshold of 1,500 ft/day. These findings supported the development of a rutting prediction model for New Jersey conditions, with recommended baseline coefficients (k_{1r}= -2.42, k_{3r}= 0.255) for full-depth porous asphalt pavement design.

Benefit to NJDOT

This research enhances NJDOT's ability to deploy porous asphalt pavements on high-traffic roadways by delivering a validated, performance-based design approach. Accelerated pavement testing was used to validate the design and develop New Jersey-specific calibration factors and rutting prediction models that support reliable design decisions for local porous asphalt mixtures. The results contributed to the development of a construction and design specification for the porous asphalt pavement systems for NJ conditions. Together, these outcomes position porous asphalt pavement as a practical, climate-resilient solution for mitigating the impacts of severe rainfall and localized flooding, while reducing implementation risk and enabling cost-effective statewide adoption.

Conclusions

Laboratory testing, full-scale accelerated pavement testing, and performance analyses demonstrated that porous asphalt pavements can be structurally designed to support high-traffic loading while maintaining permeability, without compromising rutting performance. The clogging mechanisms and the maintenance aspects of these structures need further research as these factors are imperative to retain permeability for a long term.

Related Publications

1. Eleyedath, A., Becerril Jr., G., Ali, A., and Mehta, Y. (2025). Development of a framework for the structural design of long-lasting porous asphalt pavement for high-traffic-volume roadways. *Journal of Construction and Building Materials*, 470, 140638.
2. Carroll, J., Simonsen, S., Rosas, T., Siddique, A. B. M., Eleyedath, A., Ali, A., and Mehta, Y. (2025). Laboratory Study on the Effect of Confinement on the Dynamic Complex Modulus of Porous Asphalt Mixtures. *Proceedings of Airfield and Highway Pavements 2025* (pp. 206-214).
3. Eleyedath, A., Khan, A. R., Siddique, A. B. M., Ali, A., and Mehta, Y. (2024). Laboratory Evaluation of Porous Asphalt Mixtures for Use in High-Traffic-Volume Roads. In *International Symposium on Asphalt Pavement & Environment* (*ISAP 2024*), (pp. 645-651).
4. Alfalah, A., Mitra, D., Becerril, G., Eleyedath, A., Mehta, Y. and Ali, A. (2023). Evaluation of Pavement ME prediction of rutting performance for Open-Graded Friction Course Asphalt Mixtures, *Proceedings of Airfield and Highway Pavements 2023,* pp. 97-107.

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