AID-PT

Accelerated Implementation & Deployment of Pavement Technologies

INSIDE:

On location with Performance Engineered Mixtures.

Source: FHWA

Winter NEWSLETTER 2024

U.S. Department of Transportation
Federal Highway Administration

Stakeholders Report Progress with Performance Engineered Mixtures

FHWA encourages use of PEM with incentive funding.

Source: Adobe Stock

State transportation agencies and concrete pavement professionals have traditionally accepted concrete based on measurements like strength, slump, and air content. However, these measurements have limited correlation to future performance. Recent developments in concrete testing technologies have yielded methods that are better predictors of long-term performance. Stakeholders can also benefit from using performance engineered mixtures (PEM), which result in lower cradle-to-gate embodied carbon emissions because they use optimized mixture proportions with lower cement contents.

"We need to change the paradigm that concretes are accepted, and contractors are paid, based on strength," said FHWA Senior Pavement and Material Engineer Robert Conway. "We'd like to see the emphasis shift to quality characteristics such as durability."

The FHWA, 19 State departments of transportation (DOTs) and 4 national associations representing the concrete paving industry have concluded a five-year Performance-Engineered Concrete Paving Mixtures Transportation Pooled-Fund study. The objective was to encourage the use of performance engineered mixtures (PEMs) and adoption of specifications and test methods that will help improve concrete durability.

"Incorporating PEM into a project involves answering two questions," FHWA Concrete Materials Engineer Robert Spragg. "Is this the material I want to use on this particular project? And how am I making sure the material is consistent?"

PEMs include optimized mixture designs (materials selection, gradation, cement content, etc.). When paired with advanced quality assurance methods, PEMs are more durable, economical, and sustainable.

Test method summaries are available on the PEM project website for:

- VKelly
- Box Test
- Super Air Meter
- Formation Factor/Resistivity
- Phoenix

During the study, researchers from FHWA, Iowa State, Oklahoma State, and Oregon State Universities supported States with PEM implementation through 82 workshops, meetings, and webinars, and with project-level assistance. The research team also provided States training on new PEM tests including the Vibrating Kelly Ball, Box Test, Super Air Meter, resistivity and formation factor, and Phoenix.

"These new tools can really help us make advancements in performance specifications," said FHWA Senior Concrete Engineer Michael Praul. "For years, we relied on strength testing and believed if concrete was strong, it must be durable. But knowing if it's strong enough to hold up what it needs to hold up has nothing to do with how long it's going to last. Now we have tests that tell us how long it's going to last."

To encourage use of PEM, the FHWA provided incentive funding to seven States to help offset costs of shadow testing, data collection, and reporting. A shadow project consists of identifying an existing project that uses conventional acceptance tests and obtaining additional samples during the project for performance testing.

Under this initiative, the South Dakota Department of Transportation (SDDOT) applied for $60,000 from FHWA to include PEM sampling and testing on a 10-mile project on Interstate 90 in Jackson County. It was the first time SDDOT had used the Box Test and Super Air Meter as a mix design requirement on a project. Due to this experience, SDDOT reports that it will likely add these parameters to its "Special Provision for Contractor Furnished Mix Design for PCC Pavement."

Agencies that use PEM may need to consider changing the timeframe used for concrete strength testing. FHWA Senior Concrete Engineer Michael Praul explains in this *video*. *(Source: FHWA)*

The Pennsylvania Department of Transportation (PennDOT) applied for $100,000 in incentive funds to incorporate PEM tests on a 5-mile project in Allegheny County, and a 3-mile project in Westmoreland County. Following the State's PEM pilot project, and at the suggestion of industry representatives, PennDOT created a joint committee to develop a PEM specification.

Seventeen of the 19 PEM pooled fund member States have either adopted or are considering PEM-related changes to their pavement specifications. FHWA is working with several States that were not in the pooled fund to update concrete specifications and incorporate PEM concepts.

For more information, contact Michael Praul of the FHWA Office of Infrastructure or Robert Conway of the FHWA Resource Center.

COVER IMAGE: FHWA Mobile Concrete Technology Center staff partnered with Caltrans in La Mirada, CA, to implement PEM principles into specifications. Caltrans reported reduced costs and improved test results. *(Source: FHWA)*

Balanced Mix Design Moves Asphalt Industry Forward

Source: Adobe Stock

Transportation agencies have made many changes to asphalt specifications over the years as they search for ways to improve durability. "There's been so much change in the asphalt community over the past three decades since the current Superpave mix design system was developed," said FHWA Pavement and Materials Engineer Derek Nener-Plante. "Use of balanced mix design (BMD) offers a way to handle new materials and move the industry forward."

BMD uses mechanical tests on appropriately conditioned specimens to address multiple modes of distresses taking into consideration mixture aging, traffic, climate, and location within the pavement structure. A simple way to think about it is that BMD is a way to design asphalt mixtures in a context-specific way for their application.

"BMD offers many benefits," said FHWA Senior Asphalt Engineer Tim Aschenbrener. "States may have a lot of pavement distresses with dry asphalt mixtures, and BMD will give them an opportunity to put more asphalt in those mixtures, so they get less cracking. We're also focusing on sustainability. BMD provides opportunities to use more recycled materials, and BMD performance tests give States confidence that those pavements will perform."

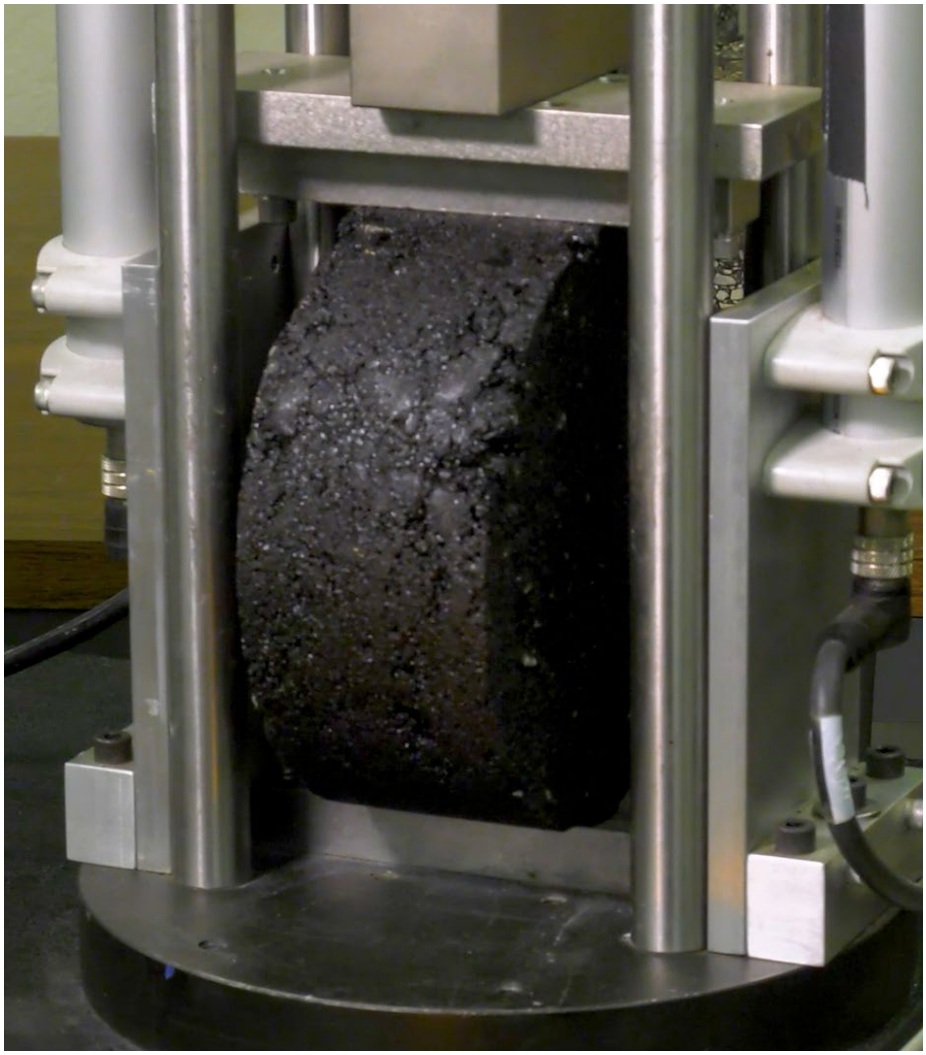
Besides better durability, stakeholders also like the flexibility BMD offers. They have the opportunity to be innovative and do what works best with their materials. For example, Texas DOT is using more recycled material and expects to reduce the cost of asphalt mixtures without sacrificing performance. Other States using BMD have experienced quality improvements—mixtures that were failing early before BMD, now are not. FHWA engineers recommend agencies first identify their BMD goals. "If you're going to get into BMD, know why you're doing it," said Nener-Plante. "Identify the problem or need, then find a solution."

> ***"Use of balanced mix design (BMD) offers a way to handle new materials and move the industry forward."***
>
> *— Derek Nener-Plante*
> *FHWA Pavement and Materials Engineer*

Research to Practice

Provisional BMD specifications were published in 2020—American Association of State Highway and Transportation Officials PP 105-20, Standard Practice for Balanced Design of Asphalt Mixtures, and AASHTO MP 46-20, Standard Specification for Balanced Mix Design. That same year, the FHWA Pavement and Materials Team held virtual site visits in seven States to capture lessons learned and hear about stakeholder experiences. The information is published in the FHWA TechBrief: Balanced Asphalt Mix Design: Eight Tasks for Implementation and was used to create a workshop. The team has held 18 workshops since 2022 and in 2023 hosted five peer exchanges. Locations included the Southeast, Northeast, North Central, Midwest, and Rocky Mountain West).

Visit the FHWA Asphalt Mixture Design and Balanced Mix Design website or contact Derek Nener-Plante of the FHWA Resource Center or Tim Aschenbrener of the FHWA Office of Preconstruction, Construction and Pavements.



Indirect Tensile Asphalt Cracking Test (IDEAL-CT) to determine the cracking potential of asphalt mixtures. *(Source: FHWA)*

Ready to deploy BMD? In this video, FHWA's Derek Nener-Plante explains what to expect and resources for getting started. *(Source: FHWA)*

Source: Adobe Stock

FHWA Resources Help States Maintain Effective QA Programs

Using quality pavement materials and practices to construct Federal-aid highways promotes safety, durability, efficiency, and long-term cost-effectiveness while also meeting regulatory standards and public expectations. Title 23, Code of Federal Regulations, Part 637, Subpart B–Quality Assurance (QA) Procedures for Construction, requires each State Department of Transportation (DOT) to maintain an FHWA-approved QA program for materials used in Federal-aid highway construction projects on the National Highway System.

Since the regulation affords much flexibility, the structure and details of each State DOT's QA program may vary to address potential risks to the quality of materials in that State. The FHWA periodically evaluates each State DOT QA program to help agencies mitigate these risks. This is done through QA stewardship reviews and QA assessments.

QA Stewardship Reviews

The FHWA created its QA Stewardship Review Program in 2003 to evaluate State QA programs, assess compliance with Federal requirements, capture and share practices, assess and reduce risks, and provide recommendations to improve material quality and program efficiency. The FHWA conducts weeklong stewardship reviews at five or six DOTs each year. Each State, plus Puerto Rico and the District of Columbia, is visited every 10 to 12 years. The 2013-2018 QA Stewardship Review Summary Report highlights 27 DOT QA program reviews. The next report will span 2019-2023 and feature 17 DOT QA programs, five of which were visited virtually due to travel restrictions in 2020. "That experience taught us that while in-person reviews are preferable and most effective, virtual visits can be useful," said FHWA QA Program Manager Jeff Withee. "Now, we sometimes use virtual visits to supplement in-person reviews, especially in large States where project locations require too much travel time. Virtual visits help us obtain a sampling of the entire State, which is important since many times different regions handle things a little bit differently."

Each State receives a final QA Stewardship Review Report that includes three categories—strengths, opportunities for improvement, and high-risk areas.

QA Assessments

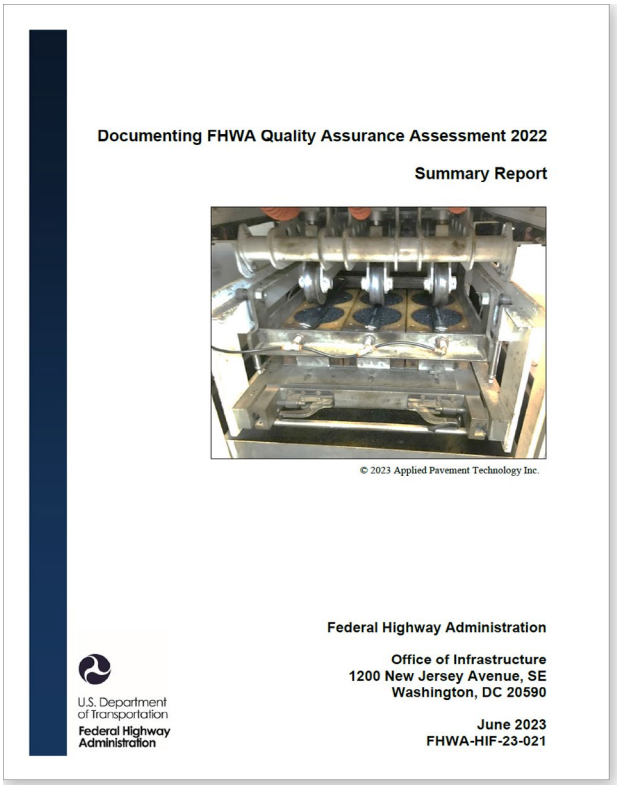
In 2008, FHWA used effective practices identified during QA stewardship reviews to create questions for a tool known as QA assessments.

"There were States that met regulatory requirements but had gaps in their QA programs," said FHWA Senior Pavement and Materials Engineer Dennis Dvorak. "We use QA assessments to evaluate the health of State DOT QA programs."

The QA assessment tool evaluates six QA program elements: agency acceptance, dispute resolution, technician certification/qualification, qualified/accredited laboratories, independent assurance, and contractor quality control processes.

QA assessments differ from QA Stewardship Reviews in several ways:

- Every State is reviewed approximately every 4 years.
- States are not visited or directly surveyed. FHWA gathers and evaluates DOT information available online.
- The assessment questions are non-regulatory and focus on effective practices and how States implement their QA program.



FHWA published the first QA Assessment Summary Report in 2023. *(Source: FHWA)*

QA assessment summary reports were only used internally until recently. FHWA published the FHWA Quality Assurance Assessment 2022: Summary Report because DOTs may find it helpful to know what their peers are doing. "We get questions where folks ask, 'How many States do it this way? Are we an outlier?'" said Withee. "If a State is having challenges, the report can help us identify a State that is taking a similar approach and connect them."

Instructor-led Training

Quality Assurance for Highway Construction Projects, a National Highway Institute (NHI 131141) 2-day instructor-led course, is another resource to help agencies mitigate QA risks. The course, updated in 2020, helps participants understand the impact and importance of operating a sound QA program, realize the associated risks to payment, and recognize risks to infrastructure performance.

Each year, the National Highway Institute offers hundreds of instructor-led classes like this one. *(Source: FHWA)*

"In the 15 years since it first launched, the NHI QA course has been effective at helping project, district, and regional staff understand why they should care about QA and its impact on project life," said Dvorak. "The course has improved participants' use of QA specifications in performing their jobs."

For more information, visit the FHWA Quality Assurance website or contact Jeff Withee of the FHWA Office of Preconstruction, Construction, and Pavements or Dennis Dvorak of the FHWA Resource Center.

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Publication Number: FHWA-HIF-24-038