Using *Performance Specifications for Rapid Renewal* in Alabama
SHRP2 CASE STUDY

Photos courtesy: Gallivan Consulting Inc., David Peshkin

Accelerating Innovation in Alabama through the SHRP2 Solution: *Performance Specifications for Rapid Renewal (R07)*

Efforts to Enhance ALDOT's Construction Program

The Alabama Department of Transportation (ALDOT) is one of five departments of transportation currently implementing *Performance Specifications for Rapid Renewal* (R07) through the SHRP2 Implementation Assistance Program (IAP), administered by the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO). ALDOT was awarded implementation assistance in 2013 in the Lead Adopter Incentive category, providing funds to help offset costs associated with product implementation and risk mitigation. This case study briefly describes the ALDOT project, goals, and implementation activities to implement *Performance Specifications*.

By developing a performance specification for asphalt pavements, ALDOT intends to further advance the quality and application of the agency's asphalt mixtures to extend the service life of their pavements. ALDOT initially upgraded its asphalt pavement materials and procedures as part of the original SHRP2 research conducted under the auspices of the Transportation Research Board. These changes included using performance-graded asphalt binders and Superpave Gyratory Compactors (SGC) to optimize roadway mixtures for various traffic and temperature conditions. The initial work concentrated on the materials and mix designs and did not address the constructability of the mixtures, which left the state and contractors to use their existing methods to place and compact the mixtures.

To address this void, in its implementation project ALDOT included assessing the value of using performance specifications for Intelligent Compaction (IC) and thermal imaging as part of its construction operations to address two critical elements related to the compaction of asphalt pavements—namely, optimizing compaction operations to

What are *Performance Specifications for Rapid Renewal (R07)*?

To help transportation agencies develop and implement performance specifications, SHRP2 created *Performance Specifications for Rapid Renewal* (R07). These model performance specifications address various project types (such as for pavements, geotechnical, and bridges) and project delivery methods (such as design-bid-build, design-build, design-build-warranty, and design-build-operate-maintain).

The conventional approach to highway construction places the burden on the owners of the facilities to design, specify, and control the work. Performance specifications, on the other hand, shift some of the agencies responsibilities to contractors and empowers them to look for new solutions to save time, minimize disruptions, and enhance safety and quality while meeting the specific goals of the project.

Included in the *Performance Specifications* product are:

- Model performance specifications;
- Ranking grids;
- Step-by-step instructions for developing performance specifications

ensure complete coverage, and generating compaction at the optimal temperatures. (For more information on the relationship between Performance Specifications and Intelligent Compaction, go here.)

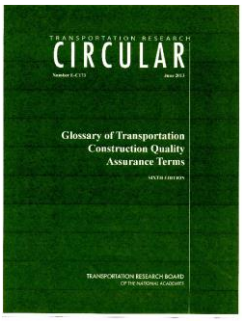
ALDOT Specifications and Project Goals

ALDOT's current specifications contain minimum requirements for density and compaction that the contractor must meet to ensure payment, and are considered to be end-result-type specifications. Alabama has created new specifications that contain requirements for both Intelligent Compaction (partially based on AASHTO PP 81-14) for assurances related to roller coverages, and thermal profiling (partially based on AASHTO PP 80-14) of the materials immediately behind the paver for determining temperature differentials in the hot mat. Roller coverages and uniform temperatures of the hot mat are critical elements needed for good compaction of asphalt materials. Advancing Intelligent Compaction is a step towards performance specifications and provides opportunities for the Department to advance the performance and life of their asphalt pavements.

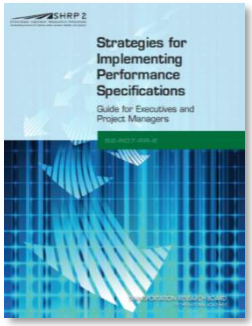
ALDOT hopes to achieve numerous objectives by using performance-related-specifications. They include:

- Supplying ALDOT with new methods to accurately and completely evaluate the roadway mat and placement practices of the contractor.
- Encouraging contractors to apply greater control and ingenuity.
- Improving project quality.
- Accelerating construction.
- Minimizing costly construction oversight.
- Reducing claims and inspection.

Challenges Facing ALDOT



ALDOT acknowledged that various issues exist with its asphalt pavement construction program and therefore targeted improving its construction specifications as the first step in the project. Initially, ALDOT considered using performance-based specifications such as resilient modulus, creep properties, and fatigue properties. After receiving technical assistance provided through the IAP effort, the agency recognized that performance-***related*** specifications such as air voids, voids in the mineral aggregate, densities, and binder content were more applicable. Performance-related specifications are considered the next generation of quality assurance specifications, since they are more quality based and can use predictive models to assign rational pay adjustments to various quality characteristics when fully developed.



Guidance document developed through the Transportation Research Board's research on SHRP2.

ALDOT'S Implementation Activities

During Spring 2015, the SHRP2 subject matter expert (SME) who was providing technical assistance to the IAP states began working with ALDOT representatives – principally with the department's materials office to advance the development of performance specifications. ALDOT used the existing AASHTO specifications for Intelligent Compaction and thermal profiling, along with examples from other states.

In September 2015, ALDOT hosted an Intelligent Compaction (IC) training course funded by FHWA for state personnel and contractors that provided an introduction to the technology and the related data management system program.

The IC workshop was successful in:

- Familiarizing participants with fundamentals of Intelligent Compaction

- Demonstrating the route to successful IC implementation
- Demonstrating the operations of the data management system program "Veta"
- Developing attendees into technology champions of IC for their organizations or companies

In November 2015, ALDOT hosted a *Performance Specifications* Peer-to -Peer Exchange in Montgomery, Alabama, with representatives from the other states that are implementing the product. The peer exchange was sponsored by AASHTO and FHWA and offered states the opportunity to hear how their peers are developing and using performance specifications. Meeting summary notes are available here.

In September of 2016, ALDOT advertised and awarded a project that includes both Intelligent Compaction and Thermal Profiling requirements: ALDOT Project No. NHF-0013(535), Lauderdale County, on SR 13 (old US 43) from the junction of SR 64 to the intersection of CR 140 south of Green Hill, Alabama. The specific project will widen and reconstruct a two-lane roadway into a five-lane facility for about two miles. Construction of the project is currently delayed due to utility issues and construction is now scheduled to begin in the fall of 2017.

In the specification for the project, ALDOT representatives acknowledged the value of training by including a section titled "On-Site IC-Infrared (IR) Training" that must be completed by both the contractors' and agency's personnel prior to the initiation of the paving operations. The training is designed to be four-to-eight hours in length and consists of hands-on activities using the data management program as well the introduction of the technologies. Personnel from the contractor must include the paving superintendent, quality control manager, and the roller operator(s). ALDOT's project engineer and field inspector(s) must attend and represent the state transportation agency.

Lessons Learned from ALDOT

During the project planning process, ALDOT recognized that the development of performance specifications requires collaboration and support between multiple divisions within the department in order to implement new technologies. In addition, the agency found that the AASHTO specifications utilizing Intelligent Compaction do not require the use of project survey markers as part of project requirements, which enabled them to more easily identify a project where they could use these technologies.

The following lessons learned have been generated from various state DOTs that are implementing performance specifications.

- The SHRP2 program has developed three documents (see the Appendix) that provide the baseline understanding of performance specifications. At a minimum, these guidelines need to be shared within any department considering the development of performance specifications.
- It is recommended that agencies need to have a better understanding of the basic definition of Method, End Result, and Quality Assurance specifications.
- State agencies need to develop realistic goals and expectations for incorporating performance specifications. Short and long-term goals and objectives are recommended and the appropriate staff should be dedicated to their development.
- The National Highway Institute has developed training courses on writing specifications. Multiple representatives from the agencies, including management, should participate in the training.
- The development of new or updated specifications is a challenge for most agencies. Through SHRP2, technical assistance can be provided to assist states interested in advancing these new technologies.

Benefits and Value of Moving Towards Performance Specifications

ALDOT efforts in the asphalt area are anticipated to demonstrate the power and adaptability of new technologies to achieve project-specific goals and satisfy the overall agency needs. Short and long-term benefits to the agencies will differ, but moving towards performance specifications will demonstrate that these new technologies will help extend

the life of rapid-renewal projects. ALDOT SHRP2 performance specifications are expected to be extended into a number of other agency operations.

Next Steps

ALDOT plans to further consider the advancement of performance specifications in asphalt pavement materials once the initial trial project is completed.

For more Information:

To learn more about ALDOT's use of *Performance Specifications for Rapid Renewal* (R07), contact *Lyndi Davis Blackburn, P.E.* at blackburnl@dot.state.al.us.To learn more about SHRP2 and the *R07* product, contact Jennifer Balis, FHWA, at jennifer.balis@dot.gov or Keith Platte, AASHTO, at kplatte@aashto.org.

FHWA GoSHRP2 Performance Specifications (R07) Website:
http://www.fhwa.dot.gov/goshrp2/Solutions/Renewal/R07/Performance_Specifications_for_Rapid_Renewal FHWA's product page includes presentations from various workshops, links to source documents, and a map showing which states are participating in the IAP program to implement *Performance Specifications* (R07).
AASHTO SHRP2 Performance Specifications (R07) Website:
http://shrp2.transportation.org/Pages/R07_PerformanceSpecificationsforRapidRenewal.aspx
AASHTO's product page offers case studies, training modules, presentations, factsheets, guidance documents, and a list of other states implementing the R07 product.

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Transportation Research Board, (SHRP2), *Performance Specifications for Rapid Highway Renewal,* Report S2-R07-RR-1, Washington, D.C., (2014).

Transportation Research Board, (SHRP2), *Strategies for Implementing Performance Specifications*, i.e. *Guide for Executives and Project Manager,* Report S2-R07-RR-2, Washington, D.C., (2014).

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Appendix

The following definitions from various TRB documents should be considered when developing new specifications.

Understanding Performance Specifications

Performance specifications are part of a development continuum process by the states to make improvements in construction operations to meet or exceed the design and performance goals of the projects. Over a hundred years ago, most states were developing prescriptive or recipe/method type specifications with the intent to provide a stable level of understanding between the agencies and the contractors on what was expected. Nearly fifty years ago significant changes to the standard project delivery methods began to take form with the movement towards quality where End-Results-type specifications were and still are used today across the country. Forty years ago, Quality-Assurance-type specifications were developed to better communicate the project's criteria and requirements with contractors, making significant changes on how the "quality" of the project was measured and accepted by the introduction of statistics in the processes to highway agencies. Performance-Type-Warranty specifications were first introduced in 1995 through changes in federal legislation that allowed warranties on Federal Aid Projects, this enabled responsibilities for the construction of pavements to be shared with the contractors. Highway agencies have now moved towards the use of performance specifications. In 2014, the Transportation Research Board in partnership with the FHWA and AASHTO developed the SHRP2 R07 guidance documents.

The SHRP2 guidance documents provide recommended approaches towards the development of performance specifications and strategies to accelerate construction, minimize disruption of traffic and communities and produce long-life facilities on our national roadways.

The conventional approach to highway construction places the burden on the owners of the facilities to design, specify, and control the work. Over the decades, construction processes have advanced beyond the control of traditional prescriptive specifications. Furthermore, most agencies have been experiencing reduction of personnel in the design and construction fields and at the same time, an expansion in the projects and new requirements due to high-speed construction, night-time construction and/or extensive rehabilitation.

The traditional way of doing business is no longer meeting the quality demands of today's projects. Performance specifications, on the other hand, shift some of the agencies' responsibilities to contractors and empowers them to look for new solutions to save time, minimize disruptions, and enhance safety and quality in the interest of rapid renewal while meeting the project-specific goals of the project.

Performance Specifications Definitions

Performance specifications vary; generally they describe how the finished product should perform over time. For highways, performance is typically described in terms of changes in the physical condition of the surface and its response to load, or in terms of the cumulative traffic required to bring the pavement to a condition defined as "failure." Specifications containing warranty/guarantee clauses are a form of performance specifications.

Other than the warranty/guarantee type, performance specifications have been used on major highway pavement components (e.g., subgrades, bases, surfaces, etc.) but use has been limited due to a lack of suitable nondestructive tests to measure long-term performance during or after construction. They have been used for some products (e.g., highway lighting, electrical components, joint sealant materials, etc.) for which there are suitable tests of performance.

Performance-Related Specifications

These type of specifications describe the desired levels of key materials and construction quality characteristics that

have been found to correlate with fundamental engineering properties that predict performance. These characteristics (for example, air voids in asphalt concrete (AC) and compressive strength of PCC) are amenable to acceptance testing at the time of construction. True performance-related specifications not only describe the desired levels of quality characteristics but also employ the quantified relationships containing the characteristics to predict as-constructed pavement performance. They provide the basis for rational acceptance/pay adjustment decisions.

Performance-Based Specifications

Performance-based specifications describe the desired levels of fundamental engineering properties (e.g., resilient modulus, creep properties, and fatigue properties) that are predictors of performance and appear in primary prediction relationships (i.e., models that can be used to predict pavement stress, distress, or performance from combinations of predictors that represent traffic, environmental, roadbed, and structural conditions). Because most fundamental engineering properties associated with pavements are currently not amenable to timely acceptance testing, performance-based specifications have not found application in transportation construction.

Intelligent Compaction Technology

Intelligent Compaction (IC) is an equipment-based technology that has been developed to improve the contractor's quality control operations and improve the performance of the pavements. IC is defined as using single or double-drum vibratory rollers with accelerometers mounted on the axel of a drum, global positioning systems and on-board computers that can display various roller operating settings on color-coded maps in real-time. Roller outputs include roller locations and passes, stiffness of the compacted materials, the roller operation (amplitude and vibrations) and the speed of the rollers. For asphalt mixtures, infra-red temperature sensors are mounted on the rollers for real-time surface pavement temperature monitoring. The history of development and usage of IC can be found in the FHWA Transportation Pooled Fund (TPF) IC final report and the Intelligent Compaction website. Intelligent Compaction technology is applicable to soils (embankments), roadway foundations (bases), and asphalt materials (Hot Mixture Asphalt (HMA), Warm Mix Asphalt (WMA), Stone Mastic Asphalt (SMA), etc.) and multiple in-place recycling technologies (Cold-In Place Recycling (CIR), Cold Central Plant Recycling (CCPR), Hot In-Place Recycling (HIR) and Full Depth Reclamation (FDR)).

Infrared Scanning Technology

Infrared (IR) is an equipment-based technology that has been developed to improve the contractor's quality control operations and improve the performance of the pavements. IR technology is placed on the asphalt paver to monitor the temperature of the mixture on the mat for temperature uniformity. More information on Infrared technology can be found under the SHRP2 R06(C) program.

SHRP2 Guidance Documents

- *Performance Specifications for Rapid Highway Renewal* (Report S2-R07-RR-1)
- *Strategies for Implementing Performance Specifications* (i.e. *Guide for Executives and Project Managers,* Report S2-R07-RR-2)
- *Framework for Performance Specifications*, (i.e. *Guide for Specifications Writers*, Report S2-R07-RR-3)