GUIDANCE FOR ESTABLISHING MIXTURE PERFORMANCE TEST CRITERIA

In addition to the lab to field validation experiment previously discussed in Step 7 of Guidance for Selecting Mixture Performance Tests, a statewide benchmarking experiment is also highly recommended to help establish appropriate mixture performance test criteria. The objective of the benchmarking experiment is to test existing mix designs being designed and produced in the state using the selected mixture performance tests to determine the distribution of test results. When selecting asphalt mixtures for the benchmarking experiment, priority should be given to those with a known history of field performance. Ideally, the benchmarking experiment would include testing of laboratory-mixed laboratory-compacted (LMLC) specimens for mix design approval and PMLC specimens for production acceptance. Comparing the test results of LMLC versus PMLC specimens will provide insights on how mix quality can change from mix design to production. There are many factors that may contribute to the difference in the test results between these two types of samples, which include changes in the binder content and aggregate gradations due to normal production variability, differences in asphalt aging and absorption, breakdown of aggregate through the plant, and variations in baghouse fines return, among others.

All performance testing for the benchmarking experiment should be conducted in a single laboratory (e.g., the SHA central laboratory or a designated third-party laboratory) to exclude between-lab variability in the test results. If contractors or other labs are involved in sampling mixtures and/or preparing specimens, then the entity leading the benchmarking experiment should provide detailed, step-by-step procedures to those labs for the sake of consistency. Once testing is completed, a database of mixture performance test results can be developed and analyzed to determine the impact of mix design and production variables on the test results, identify mix design modifications to improve test results, and most importantly, establish preliminary specification criteria for use in shadow projects.

When selecting the preliminary performance criteria, one of the questions that SHAs need to answer is, “are you satisfied with the current pavement performance in the state?” If the answer is “yes”, then the preliminary performance criteria should be selected so that they can pass most of the existing mix designs but fail those with known quality issues. If the answer is “no”, then the criteria should be set at a higher level with expectations that the overall mix quality and pavement performance would be improved upon execution of a BMD specification. Several recently completed or ongoing research studies have provided useful guidance on setting performance test criteria based on a benchmarking experiment; they are briefly discussed as follows.

- Researchers at the Illinois Center for Transportation developed a set of preliminary criteria for I-FIT to discriminate asphalt mixtures from good-, intermediate-, and poor-performing pavement sections in Illinois (Al-Qadi et al., 2015). These criteria were then further refined with additional field performance data collected since they were first developed. Based on these efforts, a minimum flexibility index criterion of 8.0 on short-term aged specimens was adopted by the Illinois DOT for mix design approval in 2016.

- In 2018, researchers at VTRC completed an in-house research study to benchmark the performance of 11 existing mix designs using a variety of mixture performance tests. Based on the test results collected, the APA, IDEAL-CT, and Cantabro test were selected as the mixture performance tests for BMD in Virginia. Furthermore, a set of preliminary test criteria were developed for use in a provisional specification on BMD by considering the historical performance of these 11 mix designs along with findings and recommendations from other relevant research studies.

- NCAT researchers have been conducting two benchmarking experiments to assist the Georgia DOT and Wisconsin DOT with the implementation of BMD. The Wisconsin benchmarking experiment consists of testing LMLC specimens for 18 mix designs using the HWTT, IDEAL-CT, and Disc-shaped Compact Tension (DCT) test, while the Georgia experiment focuses on the IDEAL-CT testing of PMLC specimens for 42 mix designs. Test results, data analysis, and research findings of these two benchmarking experiments will become available in spring 2021.

In addition to conducting a benchmarking study, SHAs should consider performance criteria recommended from well-designed, well-constructed field experiments. Examples of such experiments include the top-down cracking experiment at the NCAT Test Track, the thermal cracking experiment at the Minnesota Road Research Facility (MnROAD), and other pooled-fund experiments with multiple test sections. Agencies should also consider building one or more Long-Term Pavement Performance (LTPP) style field experiments in their own state to help establish appropriate BMD criteria for their state. This kind of experiment takes a great deal of planning efforts and requires at least five years to obtain useful long-term pavement performance data, but ultimately will serve as a great source of data for establishing preliminary test criteria for BMD. Although not recommended, some SHAs may also opt to adopt the existing performance test criteria used in other states.

There are two key questions that must be answered when setting preliminary criteria: “are the performance criteria under consideration achievable for the existing mix designs in the state?” and “can the performance criteria discriminate the good-performing versus poor-performing mixes with a known history of performance data?” If the answer to at least one of these questions is “no”, then the performance criteria should be adjusted to better suit the local conditions in the state.

Another step in the effort to set preliminary performance test criteria is the execution of shadow projects. A shadow project is an existing project that using the SHA’s current acceptance tests (e.g., asphalt content, gradation, VMA, etc.) but additional plant mix samples are obtained throughout the project for mixture performance testing. The performance test results are for informational purposes only as there would be no changes to either the contract or the specifications for the project. The performance testing would be performed by the SHA at either their central or district laboratory but could also be performed by the contractor. The shadow project has three goals: first, familiarize agency and contractor personnel with the selected performance tests; second, add to the database of test results from the benchmarking experiment; and finally, gather information about the impact of production variability on the performance test results. In addition to the laboratory test results, field performance data of the shadow project should also be collected, which allows the agency to further verify the preliminary performance test criteria and make appropriate adjustments if needed. SHAs are recommended to revisit their performance criteria on a yearly basis to ensure that they are suitable for accepting asphalt mixtures with good rutting and cracking performance for mix design approval and production acceptance.