What We Have Learned About

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Since 1992, when only a few Superpave projects were placed, much has been learned about Superpave, a new system intended to provide better performing asphalt pavements. For the most part, Superpave has worked well. But, as with anything new, there have been some growing pains. This article will review some of the experience gained with Superpave binders, mix designs and pavements.

Field Experience Superpave

So far, experience with producing, placing and compacting Superpave mixes has shown that they act much like conventional mixes. Fine-graded mixes with binders similar to those used in the past are relatively easy to place and compact. Coarse-graded mixes, and those with large top-size rocks, or those with a stiff binder, require more attention to good construction practices and more effort to compact. For example, a 37.5 mm Superpave mix behaves much like the big rock mixes already being used. They may segregate if handled poorly and may be somewhat more difficult to compact.

Generally, plant operations for Superpave mixes are very similar to those required for conventional mixes. Wide ranges of aggregate sizes and blends have already been successfully produced by existing equipment. The experience gained with stone matrix asphalt (SMA) mixes and open-graded friction mixes have demonstrated the flexibility of HMA producers to adapt to unconventional mixes. Using some of the stiffer, high-temperature PG grades require slightly higher pumping and mixing temperatures. However, producers should avoid extreme temperatures—more than 350°F—to prevent excessive aging of the binder and/or damage to the modifier.

Compaction Superpave

Compacting a Superpave mix depends on the characteristics of the mix itself. Coarse-graded mixes, or mixes with a stiff binder, are mostly readily compacted at relatively high temperatures (250°F plus). The most efficient way to get them compacted is to keep the breakdown roller, and preferably the intermediate roller, right behind the paver.

Another good practice with Superpave mixes is to construct and evaluate one or more test strips. Many contractors try to use exactly the same rolling set-up whether it is April or August, or whether the course thickness is 25 or 75 mm. The rolling pattern that worked for one project may not work under the next project's conditions. An added benefit of a test strip is the opportunity to gain experience with density testing. The gauge may correlate differently with cores from Superpave jobs that have a more coarse texture.

Lift Thickness Superpave

Another lesson learned from our Superpave experience is that the old rule-of-thumb of using 2 to 2.5 times the topsize aggregate as the minimum lift thickness may not be applicable to Superpave mixes. Superpave technology defines the top-size and nominal maximum size aggregate one size smaller than does a typical state DOT. This definition, along with commonly used higher concentrations of coarse aggregate, requires increased lift thickness to achieve the workability needed for proper compaction. A ratio of 3 to 4 times the nominal aggregate size to the minimum lift thickness is recommended. Due to the increased cost of placing this additional thickness, some agencies may elect to go to a smaller top-size mix to stretch their paving dollars.

The coarser and larger top-size Superpave mixes exhibit more segregation than dense-graded and smaller top-size aggregate blends that are standard in many areas. Contractors and road agencies who have little experience with these coarser Superpave mixes must rely on "good construction practices" for managing segregation. Proper aggregate stockpiling, surge-bin operations, truck loading and unloading procedures, and paving machine materials levels all must be carefully controlled to lessen the possibility for aggregate size separation.

Tender Zone Superpave

Another problem that has shown up is tenderness on the Superpave mat during compaction. Tenderness was not anticipated as a problem with Superpave mixes, and the exact cause and means of prevention are not yet fully understood. We do know that tenderness is normally attributed to excess fluids such as asphalt cement, moisture and fine fillers.

Until we can determine the cause and resolve the problem, a couple of strategies are being used to successfully compact a tender mix. One option is to obtain as much

Superpave

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compaction as possible with the breakdown and intermediate roller before the mat cools to the "tender zone," which is approximately 245° to 200°F. When the mat becomes tender, further rolling with steel-wheel equipment is counterproductive until the mat cools below the tender zone. If a rubber-tired roller is available, it can continue to roll and increase the mat's density while the course is cooling. If a rubber-tired roller is not available, nothing productive can be done until the mat cools and stiffens at around 200°F. When a tender mix is encountered, the mix design and production

Binders

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Most asphalt suppliers and users are now familiar with the PG binder system. After some early problems, we found the testing equipment to be increasingly reliable. A Supplier Certification process has been developed that allows for timely shipment of material. Several research efforts are underway to address other critical concerns.

Research project NCHRP 9-10, *Characterization of Modified Binders,* is intended to improve Superpave's ability to characterize modified binders. This project is

improved laboratory aging methods to better represent the service-life properties of modified binders.

Another research effort, NCHRP 9-12, *Incorporation of Reclaimed Asphalt Pavement in the Superpave System,* is looking at several issues pertaining to the use of RAP in Superpave mixes. The issues include: improving procedures to extract and recover the RAP binders, determining the extent of blending that actually takes place between the RAP and virgin binders, and evaluating the behavior of mixes incorporating RAP.

Binder Test Procedures

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improve repeatability, the Direct Tension Test will now use aluminum instead of silicone sample molds, and will use potassium acetate solution in the cooling bath. The Bending Beam Rheometer (BBR) will receive new sample supports and upgraded software to address the differences in results between rheometers made by different manufacturers.

Field experience has shown that PG binders share about the same sensitivity to contamination and intermixing as conventionally tested asphalts. It's important to remove all of the old asphalt from plant-site storage tanks before adding the PG binder. Changes in grade can also occur when adding silicone and antistripping agents. The user agency must be aware of the addition of these materials so the verification results can be interpreted correctly.

Mix Designs Superpave

Most mix designers now need fewer aggregate trial blends to select the combination of aggregates needed to meet Superpave requirements. Unlike the situation a couple of years ago, it is no longer routine to need 10 or more trial blends to find one that will work. Those designers who lack experience can now get advice from several sources, including the Lead States (Florida, Indiana, Maryland, New York, Texas and Utah), the Superpave Centers, DOT designers and commercial labs.

Additional models of the Superpave Gyratory Compactors (SGCs) have been approved for use. Some of the new machines are lighter and more portable and require less floor space, which is a real plus at many field labs.

Refinements Superpave

Several refinements to the volumetric mix design procedure are being considered. Revision of the N_{design} table and listing the number of compaction gyrations to be applied is likely. There will probably be fewer categories, and the numbers will likely be rounded. Consideration is also being given to ending the compaction at N_{design} rather than continuing the compaction out to $N_{maximum}$.

Also being debated is whether N_{design} should be the same for both base and surface mixes. Some consideration is being given to reducing the compactive effort applied to mixes being placed below the 100 mm level in the pavement structure.

Another mix design-related development is the practice of some designers filling relatively open, high-air-voids-content structures with asphalt to reach the 4 percent voids level. This results in "wet side" design of the VMA curve, which can cause the individual aggregate particles to be pushed apart by the binder. Not only are these wet side mixes costly to produce, but they are potentially conducive to rutting or shoving—just as we previously learned with Marshall designs. Extreme caution should be exercised when the VMA exceeds the required minimum value by a significant amount (around 2 percent). These aggregate structures may need to be redesigned to reduce the voids level.

Superpave Benefits Superpave

Much has been learned, and much remains to be learned about Superpave. A vast amount of experience will be gained from increased usage of the new technology, from test sites such as Westrack, and from products such as NCHRP and other research efforts.

Several benefits have already been gained from Superpave:

- better binders from improved lab-aging procedures
- more detailed, low-temperature testing protocol
- improved mix design procedures through optimization of the aggregate structure
- a compactor that better represents compaction characteristics in the field.

One of the biggest benefits of Superpave may be the awareness that it has created regarding the importance of ingredient materials and their production processes. Failures are not an invention of Superpave. We had them with the old system, and we'll likely continue to have some as we gain experience with the new procedures. Superpave is a system that will take time for full implementation. We are in it for the long haul, so let's learn from our misadventures, share the lessons we learn, and pave on. Superpave will eventually return a good dividend on our investment. ▲