Guidance for Introducing Performance Based Concrete Mixtures in Arkansas

Problems Statement:
Performance engineered mixtures (PEM) refers to the design of concrete mixtures to meet fresh and hardened concrete standards that can be directly correlated to long term pavement performance. Current test methods and standards often put too much emphasis on prescriptive requirements (i.e. minimum cement content, maximum w/c ratio). Mix performance related specifications could provide less costly and more environmentally friendly mixes while still ensuring high quality pavements in the long term. In Texas, PEM resulted in 10% cost savings and reduced cement contents for pavement mixes. Acceptable mixes can be produced with as little as 4.5 sacks of cementitious materials and 20% fly ash.

A slew of new test methods for fresh and hardened concrete have been developed in the past 10-20 years that emphasize pavement performance. These new tests are more capable of measuring performance related properties of concrete than the traditional test methods (slump, air content, etc.). In order to implement these new test methods, acceptable standards must be prepared by the state for concrete mixtures at the mix design stage and in the field. The new test methods include: box test and VKelly test (workability and consolidation), super air meter (entrained air distribution), concrete resistivity (Wenner probe), and durability (water absorption test).

Objectives:
Design a series of concrete mixtures using both the PEM framework and the current ARDOT specifications. Perform fresh and hardened concrete tests on these mixtures using both performance based and traditional test methods. Perform longer term lab testing (freeze thaw, rapid chloride permeability, ASR susceptibility) to evaluate performance of the mixes and compare these metrics to the new performance based testing. Combine this information to select which test methods will work best for Arkansas.

Form of Research Implementation:
Research will result in acceptable limits for the new test methods and example mix designs to potentially implement in the field and monitor over time. Guidance will be provided on the new tests methods that are best suited for use in the state of Arkansas. The new tests and mix design criteria should provide more durable, longer lasting mixes. Potential reductions in cement content could reduce costs by $5.64/yd3 (based on $100/ton cement cost and reducing CM from 6 sacks to 4.5 sacks). The findings could be used to improve portland cement pavements and/or bridge decks.