ABSTRACT

Hekmatfar, Ali. Ph.D., Purdue University, May 2016. Improving the Laboratory Design of Asphalt Mixtures to Enhance Asphalt Pavement Durability. Major Professor: John E. Haddock.

Most departments of transportation, including Indiana, currently use the Superpave mixture design method to design asphalt mixtures. This method specifies that the optimum asphalt content for a given gradation be selected at 4 percent air voids. During construction, these mixtures are typically compacted to 7-8 percent air voids. If mixtures were designed to be more compactable in the field they could be compacted to the same density as the laboratory mixture design, which would increase pavement durability by decreasing the in-place air voids. The objective of this research was to enhance the asphalt mixture design method in order to increase in-place asphalt pavement durability without sacrificing the permanent deformation characteristics of the mixture.

Three asphalt mixtures were designed using the standard Superpave design method at 100 gyrations of the Superpave Gyratory Compactor, suitable for traffic levels of 3 to 30 million Equivalent Single Axle Loads. Each mixture was then used as a starting point to design three additional mixtures using 70, 50, and 30 gyrations, with optimum binder content chosen at 5 percent air voids, rather than the currently specified 4 percent. The effective asphalt content was held constant for the original and redesigned mixtures. Permanent deformation characteristics of the sets of four mixtures were determined by measuring the dynamic modulus and flow number. The results suggest that the mixture designs produced using 70, 50, and 30 gyrations had permanent deformation characteristics equal to or better than the original 100-gyration mixtures.

After promising laboratory results, two field trials were placed on SR-13 near Fort Wayne Indiana and on Georgetown Road in Indianapolis, Indiana. Samples from the standard and re-designed mixtures collected during construction were compacted and tested to determine permanent deformation characteristics. The results suggest that the re-designed mixtures should have similar permanent deformation performance to their standard mixture counterparts. Field density test results indicate the re-designed mixtures can be field compacted to 5 percent air voids using the same compactive effort as was used for the standard mixtures.