미국의 아스팔트기술연구소(NCAT)의 기술동향

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아래의 글은 미국 NCAT(National Center for Asphalt Technology)의 연구결과입니다. NCAT Test Track의 1단계 연구로서, 2000년에 소성변형 연구에 초점을 맞추어 시험구간을 시공하였으며 그 결과를 아래와 같이 보고하고 있습니다. 2004년 초부터 한국도로공사에서 시험도로를 운영하고 있는 시점에 나온 연구결과이므로 많은 참고가 될 것으로 생각됩니다.

Evaluation of Rutting Performance on the 2000 NCAT Test Track

The primary objective of the 2000 NCAT Test Track was to provide an accelerated loading facility that could be used to rapidly test a large number of test sections simultaneously. Primarily, the test sections were comprised of materials selected by the different sponsors (highway agencies) to answer local questions about the performance of their HMA under accelerated loadings.

The objective of this paper was to use the results from the 2000 NCAT Test Track to compare laboratory rutting tests and field performance for a number of mixes subjected to similar loadings that were representative of actual traffic. Also, several mini experiments were evaluated: performance of fine graded vs. coarse graded mixes, effect of asphalt binder grade on performance, effect of aggregate type on performance, and performance of several mixture types including Superpave, SMA, and open graded friction courses. After the planned 46 test sections were constructed in September 2000, a total of 10,000,000 ESALs were applied over a 2-year period. The ESALs were applied with four fully loaded trucks with three trailers per tractor. A total of eight aggregate types (or combinations) were utilized in the 46 sections of the Track. These aggregate types included: siliceous gravel, granite, limestone/slag, sandstone, limestone/recycled asphalt pavement, limestone, limestone/gravel, and marble schist. All surface mixes utilized 9.5 or 12.5㎜ nominal maximum aggregate sizes (NMAS). Five general gradation shapes were placed on the track: gradations passing above the Superpave designed restricted zone (ARZ), gradations passing through the restricted zone (TRZ), Superpave gradations passing below the restricted zone (BRZ), stone matrix asphalt (SMA), and open-graded friction courses (OGFC). The predominant method of compacting samples during mix design was the Superpave gyratory compactor (SGC). A total of 34 mixes were designed using the

SGC with a design number of gyrations (N_{design}) of 100. Two mixes were designed using 125 N_{design} gyrations. All of the SMA mixes were designed using a Marshall hammer with 50 blows per face. Five Superpave designed sections intentionally targeted binder contents that were 0.5 percent higher than optimum. Three different asphalt binder grades were used within the mixes on the Track: PG 64-22 (meeting high temperature requirements above 67C), PG 70-28, and PG 76-22. For the modified binders (PG 70-28 and PG 76-22) three different modifiers were used: SB, SBS, and SBR. Based upon the test results and analyses, the following conclusions were drawn:

- The amount of permanent deformation in all of the test sections was very low. Permanent deformation essentially stopped when the air temperature was less than 28° C. The accumulation of permanent deformation in the second summer was significantly less than the first.
- Under traffic, mixes containing PG 64-22 densified more than the mixes containing PG 76-22 binder. This may indicate that slightly more binder can be added to mixes with two high temperature binder bumps to improve durability without sacrificing rut resistance. As expected, the binder layers containing PG 64-22 densified less than the surface layers containing PG 64-22.
- The amount of permanent deformation was over 60 percent less in the sections that contained PG 76- 22 as compared to the sections containing PG 64-22.
- The performance of the coarse graded and fine graded mixes was about the same. Hence, this study indicates that similar performance would be expected for coarse graded and fine graded mixes with respect to permanent deformation.
- Adding an additional 0.5 percent binder above optimum to the mixes produced with PG 64-22 increased permanent deformation by approximately 50 percent. However, there was no significant increase when an extra 0.5 percent binder was added to mixes produced with PG 76-22.
- The secondary slope calculated from the repeated load permanent deformation test produced the best correlation with final deformation values. However, the test is highly variable. In excess of three replicates will be needed to produce statistical conclusions.
- The results from the dynamic modulus test indicate no relationship with field deformation. However, testing did deviate from the NCHRP 9-19 protocol. Due to the small amount of rutting, many sections will remain in place for another two years of traffic to better evaluate rutting potential and gain some early indications of the mixtures durability.