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Accelerated Loading Evaluation of Foamed Asphalt Treated RAP Layers in Pavement Performance

INTRODUCTION

The current specification of the Louisiana Department of Transportation and Development (LADOTD) calls for a Class-II crushed stone base layer in its flexible pavement construction. Due to a lack of high-quality stone aggregates and steadily increasing the costs of imported stone materials, LADOTD is continuously seeking for alternative base materials in lieu of a regular stone base. This report documented the research efforts conducted at the Louisiana Transportation Research Center (LTRC) regarding foamed asphalt treated reclaimed asphalt pavement (RAP) alternative base materials and provided detailed information on experiment design as well as conducted field and laboratory tests. Note that this report is one of a series of reports that document the results of a recently completed accelerated pavement testing (APT) experiment conducted at the LTRC's Pavement Research Facility (LTRC Research Project No. 03-2GT: Accelerated Loading Evaluation of a Sub-base Layer on Pavement Performance).

OBJECTIVE

The objective of this study was to evaluate the field performance of foamed asphalt treated RAP base materials as compared to a conventional crushed stone base under accelerated loading.

SCOPE

This study mainly dealt with the accelerated loading of three full-scale APT flexible pavement test sections using the Accelerated Loading Facility (ALF). Each APT test section was 107.5 ft. long and 13 ft. wide, constructed using normal flexible pavement construction practice. The scope included construction of test sections, field instrumentation, non-destructive testing, a surface distress survey, and evaluation of pavement structural performance of tested sections. In addition, a series of laboratory engineering performance-based tests including resilient modulus, permanent deformation, and loaded wheel tracking were performed to characterize the performance of utilized materials in the APT experiment.

METHODOLOGY

The APT experiment included three different base test sections: the first one contained a foamed asphalt treated 100% RAP base course (called FA/100RAP), the second used a foamed asphalt treated 50% RAP and 50% recycled soil cement base course (called FA/50RAP/50SC), and the third had a crushed limestone base. As outlined in Figure 1, the three APT sections shared a common pavement structure: a 2-in. asphalt wearing course, an 8.5-in. base course, and a 12-in. lime-treated working table layer over an A-6 soil subgrade. Each section was instrumented with one multi-depth deflectometer (MDD) and two pressure cells for measuring ALF moving load induced pavement responses (i.e., deflections and vertical stresses). The instrumentation data were collected at approximately every 8,500 ALF load repetitions; whereas, non-destructive deflection tests and surface

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distress surveys (for surface rutting and cracking) were performed at every 25,000 ALF load passes. To expedite traffic-induced pavement deteriorations, two 2,300-lb. steel load plates were added to the ALF load assembly (with a self-weight of 9,750 lb.) specifically at the loading cycle numbers of 175,000 and 225,000, respectively.

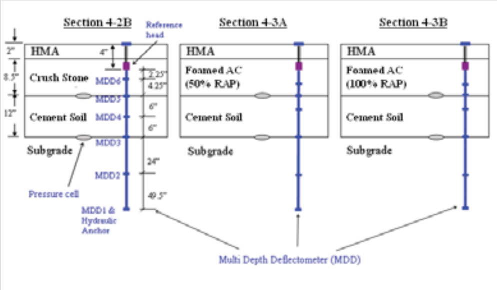

Figure 1
Pavement structures of ALF test lanes

The average surface rutting measurements for the three sections tested are presented in Figure 2, marked with the corresponding ALF load levels during different load repetitions.

Dynaflect deflection results were used to determine pavement structural capacity of test sections in terms of the structural number. In-situ elastic moduli of pavement layers were backcalculated from the falling weight deflectomoter (FWD) deflections. ALF wheel load induced pavement deformations and vertical stresses from MDD and pressure cells were analyzed to determine the break-down contributions of each pavement layer in a total surface measured rut depth and the load carrying capacity of each base material evaluated. The rutting development of each test section was simulated using a pavement analysis computer program, VESYS 5W and compared to the results measured from MDDs. Both laboratory and APT measured results were used in the failure analysis of test sections. In addition, the construction costs of using foamed asphalt treated RAP base materials were estimated.

CONCLUSIONS

The overall APT results indicated that the two foamed asphalt base materials did not perform better than or at least as well as the crushed stone base. A lack of moisture resistance was a primary issue for the foamed asphalt treated RAP materials. It was also found that both foamed asphalt treated materials could have performed better than a crushed stone base course if the applied ALF load was kept at 9,750 lb. It was due to the increase of the ALF load levels that resulted in a shakedown failure for the two foamed asphalt test sections. The shakedown analysis indicated that the foamed asphalt treated RAP base materials seemed to have a lower shakedown threshold stress than the crushed stone base evaluated. Forensic investigation revealed that the early failure on the FA/50RAP/50SC section could be attributed to both water susceptibility and weak aggregate skeleton design of the foamed asphalt mixture used; whereas, the premature failure on the FA/100RAP section was due to the combination of poor water resistance of the foamed asphalt mixture as well as an over-asphalting problem found in this section. Cost analysis showed that, when RAP materials are largely available and have a reasonable transportation cost, using a foamed asphalt treated RAP base in pavement construction has a potential to save construction costs compared to using a crushed stone base.

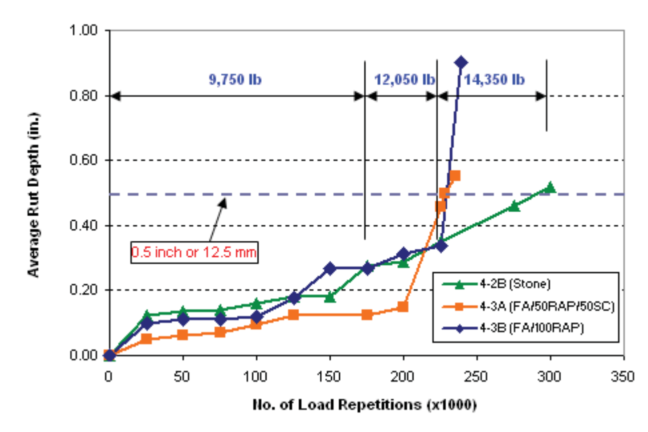

Figure 2
Measured rutting development on test sections

RECOMMENDATIONS

Due to the potential cost benefit and excellent performance under an ALF load of 9,750 lb., the two foamed asphalt mixtures evaluated in this study could be used as an alternative to other base course materials on low volume roads in Louisiana, where the percentage of heavy truck traffic is relatively low and the environment is relatively dry (or has a good drainage system).