JERSEY DOT'S

"Turning Problems into Solutions"

Tech Brief

Characterization of NJ HMA – Part I

FHWA-NJ-2002-027-TB March 2003

SO, HERE'S THE PROBLEM…

- The rutting of hot mix asphalt (HMA) pavements in New Jersey is the primary pavement distress encountered
- The Asphalt Pavement Analyzer (APA) has been found to be a very effective method of evaluating HMA mixes that are rut susceptibility
- Currently, there is no performance test related to the designing of HMA, only volumetric checks. Although a simple performance test is currently under development by NCHRP researchers, preliminary reports have found that the test is not as simple as industry wanted. The sample preparation has also been highly scrutinized as being to cumbersome
- At the moment, the APA is only used as a comparative tool to compare HMA mixes. Therefore, some type of criteria would need to be developed to make that APA into a simple performance-type test

AND, HERE'S OUR SOLUTION

- Utilize the Asphalt Pavement Analyzer (APA) after the volumetric mix design as a performance evaluator
- Develop a set of criteria, based on the APA data, that relates to the performance of the mix to the anticipated traffic load
- Verify the criteria with HMA mixes that have a historical background of having either good or poor rut resistance

We set out to develop a rutting criteria to be used with the Asphalt Pavement Analyzer (APA) as a means of evaluating the performance of HMA designs. The goal was to have a test method and criteria that was based on the need for the material to be rut resistant. This was incorporated by introducing traffic to the criteria via the N_{design} used in the mix design. An initial literature search found two states, Arkansas and Oklahoma (Figure 1), that currently have a proposed APA rutting criteria based on traffic that uses the identical testing specifications currently adopted by the NJDOT. These states were used as a starting point for the development.

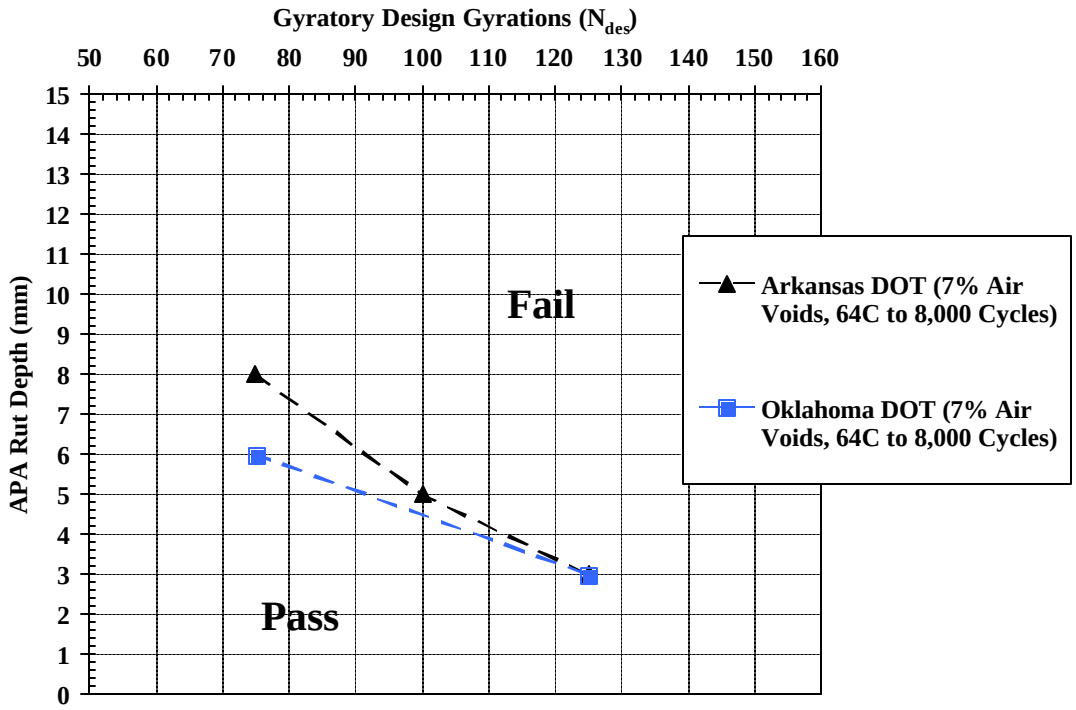

Figure 1 – Arkansas and Oklahoma DOT APA Rutting Criteria

HERE'S WHAT IT LOOKS LIKE… AIN'T IT A BEAUTY!!!

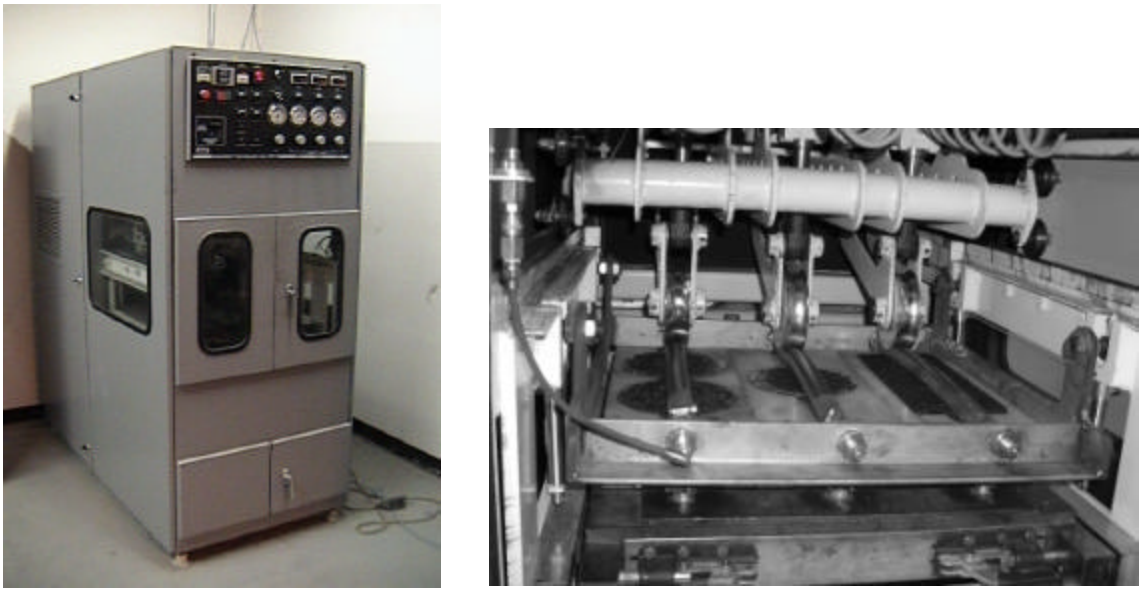

Figure 2 – Asphalt Pavement Analyzer (APA)

The use of the Asphalt Pavement Analyzer (APA) (Figure 2) has become a popular test for transportation agencies to use. The test has shown to be both robust and repeatable. It is simple to use, with a minimal amount of data processing. This allows

for a testing system that can be easily maintained and calibrated by industry, state representatives, and academia.

The APA's loading mechanism is as such; a moving wheel load (100 lbs) is applied at a rate of about one cycle per second to a ¾ inch 100 psi pressurized hose that rests atop the HMA samples. This simulates (on a small scale) the pavement loading that occurs on an HMA pavement.

THIS IS WHAT IT CAN DO

To be utilized as a simple performance tool to evaluate the rut susceptibility of HMA designs. The designs must meet the criteria developed based on the anticipated traffic level (N_{design} used during the Superpave design). The criteria is used under a pass/fail acceptance, where if the design does not meet the APA criteria set for that traffic level, the designer must start again, either changing the aggregate gradation or bumping up the binder grade.

HERE'S WHAT WE CAME UP WITH…

The development of the criteria encompassed using four different aggregate gradations, three different binder grades, and three different traffic levels (very heavy – V, heavy – H, and medium – M). The low traffic gyration level was not considered since many of New Jersey's roads do not fall under this type of traffic level. Not to mention, the primary failure mechanism in the low volume roads is not rutting, but fatigue.

The APA rutting results were analyzed and assumed to fall under a 50% probability (normal distribution). This means that it was assumed that the mixes designed at the Rutgers University Asphalt/Pavement Laboratory (RAPL) had a 50% chance of being a rut susceptible mix (Figure 3). It was concluded to develop the APA rutting criteria under this assumption because a more conservative criteria could always be increased in the future once more data was available. The final APA Rutting Criteria developed using this methodology is as shown in Table 1.

Table 1 – NJDOT APA Rutting Criteria

Superpave N_{design}	APA Rutting Criteria
75 (Medium)	< 8.0 mm
100 (Heavy)	< 5.0 mm
125 (Very Heavy)	< 3.0 mm

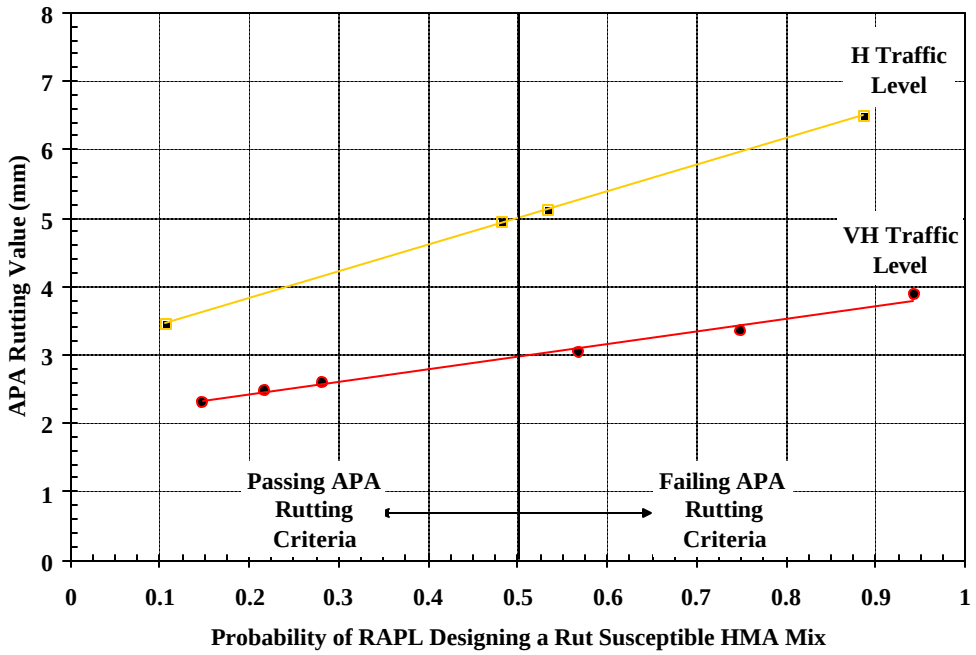

Figure 3 – RAPL 50% Probability of APA Rutting Results

When super-imposing the criteria boundaries on the Oklahoma and Arkansas criteria, the New Jersey criteria matches identically to that of the Arkansas data (Figure 4).

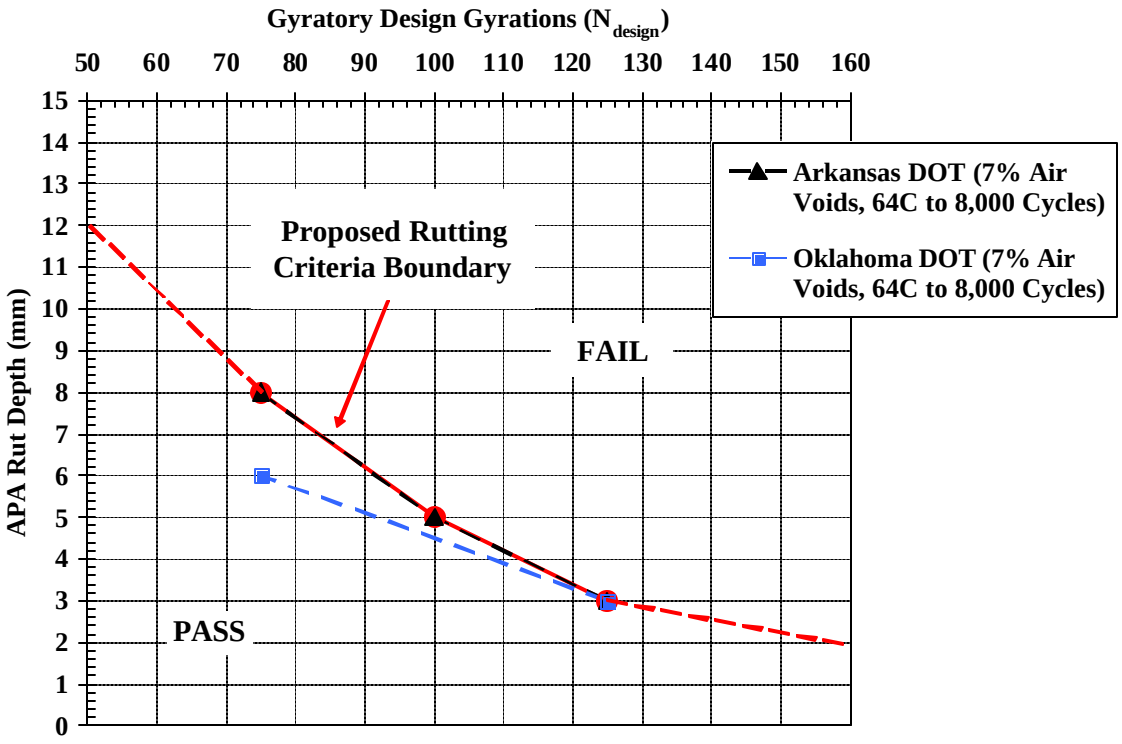

Figure 4 – New Jersey, Arkansas, and Oklahoma DOT APA Rutting Criteria

The verification of the criteria was accomplished mainly at the very heavy traffic level using the Port Authority of NY/NJ heavy volume mixes (HVM) (Figure 5). The HVM mixes were developed and used by the Port Authority after years of experience. Therefore, these mixes have a good history of being rut resistant mixes.

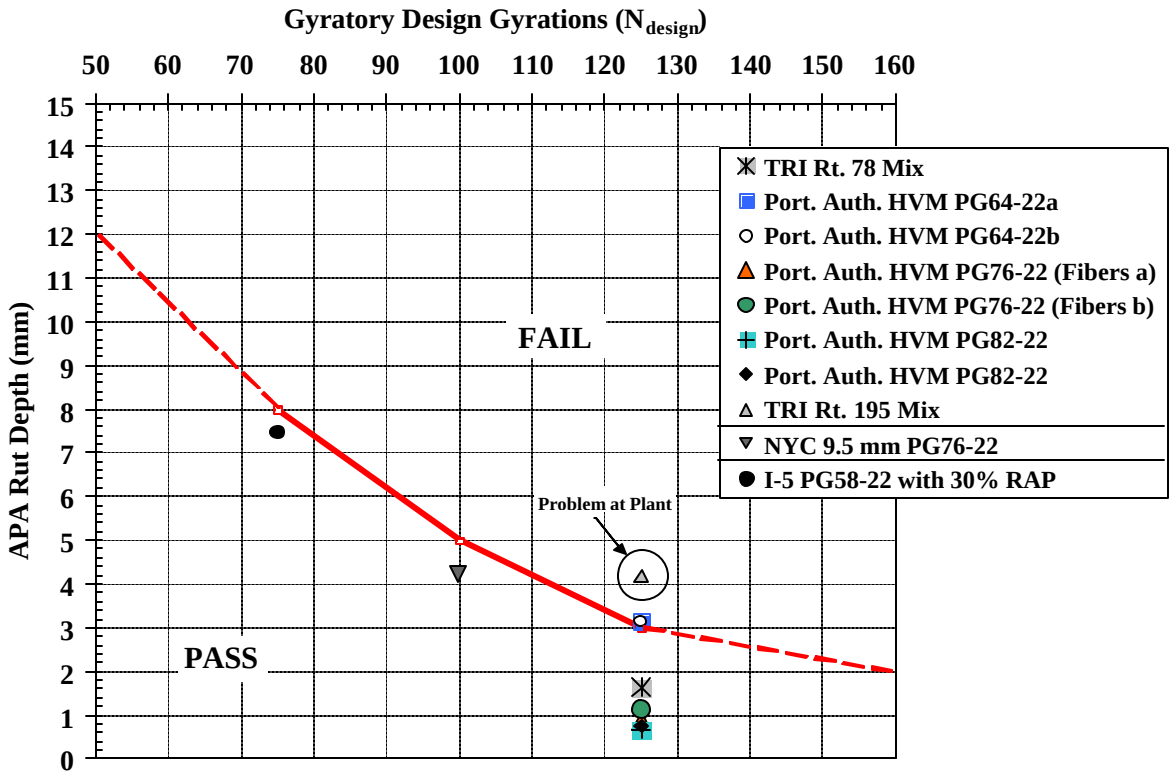

Figure 5 – Verification of Rutting Criteria

All of the Port Authority's HVM mixes passed the criteria, except for the mixes using a PG64-22 binder. This emphasizes the need of a modified binder at higher traffic levels.

THE BOTTOM LINE…

A rutting criteria to be used with the Asphalt Pavement Analyzer was developed as a simple performance test after mix design. The criteria is based on the traffic level, emphasizing the need for more rut resistant mixes at the higher traffic levels. The criteria was also verified, although more so at the very heavy traffic level, with mixes of known performance.

While this study was able to develop a rutting criteria for the Asphalt Pavement Analyzer to be used after mix design, there are certain limitations to the criteria.

1. It should only be used with laboratory prepared mixes compacted to 7% (+/- 0.5%). Field cores were not used during the development.
2. The rutting criteria only pertains to materials (aggregates and binder) typically

used in New Jersey. The criteria may not be valid for materials used outside of this region.

3. While initial criteria values for each traffic level are given, the values can be modified in the future once more performance data becomes available.

FOR MORE INFORMATION CONTACT

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A final report is available online at
http://www.state.nj.us/transportation/research/research.html

If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research, Technology Transfer Group at (609) 530-3722 or send an e-mail to Research.Bureau@dot.state.nj.us and ask for:

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