



Tech Brief

Replacement of Rolling Straightedge with Automated Profile Based Devices

Need a solution?
Think Jersey DOT

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BACKGROUND

Improving the performance of asphalt pavements is an on-going goal for highway agencies, pavement designers, and contractors. Advances in pavement design, asphalt mix testing and design, and construction equipment have helped to achieve this goal, however no real improvement can be achieved without improving the current Quality Control/Quality Assurance (QC/QA) practices.

HERE'S THE PROBLEM

Smoothness testing of finished asphalt surfaces with a 10-foot Rolling Straightedge (RSE) is a quality control/quality assurance practice that is a required inspection under New Jersey Department of Transportation Quality Control/Quality Assurance specifications. Although it is simple and does not require expensive equipment, RSE is very time consuming and requires lane closures



AND, HERE'S THE SOLUTION

The ideal solution would be to develop automated highway profilers to replace Rolling Straightedges, in order to implement the department smoothness specifications set forth by the New Jersey Department of Transportation.

BUT HOW CAN IT BE DONE?

To improve smoothness testing, evaluation of the applicability of using automated highway profilers to replace RSE should be conducted. This can be done by establishing two categories of profilers and comparing them with the existing Rolling Straightedge technique.

THESE ARE OBJECTIVES...

- To improve current Quality Control/Quality Assurance practices.
- To determine a replacement for the current Rolling Straightedge method of inspecting pavement smoothness and construction quality.

HERE IS WHAT WE DID...

The study was limited to asphalt surfaced pavements. Two categories of automated highway profilers were considered in this evaluation: portable and full size. For this study, two portable (low speed) profilers, three (high speed) profilers, and two of NJDOT's Rolling Straightedges were used. Three levels of initial smoothness were established: very smooth, smooth and relatively rough pavements. Because Rolling Straightedges and low speed profilers require lane closures, site conditions had to be considered in selecting test sections. Therefore, perspective test sections with high volumes of traffic or single lane per direction were excluded. Twenty-two test sections were selected for detailed field testing.

The field testing research consisted of three phases. During Phase I, the RT 3000 was used to scan the test sections. The collected data was used for determining test sections that satisfied the requirements. The second phase was a survey of the test sections using the Rolling Straightedges and the lightweight profilers. The third phase was the survey of the test sections using the high-speed profilers. A single RSE test was performed on each wheel path of the test sections. The light weight profilers testing consisted of the right and left wheel paths, three times each, at the speed recommended by the manufacturer. The high speed profilers testing consisted of a minimum of three repeated runs.

Collected data underwent several analyses. These included preliminary analysis, RSE simulation, statistical analysis, effect of speed analysis, and correlation analysis. The preliminary analysis was conducted on the results of the RSE inspection, in order to select test sections that matched the study requirements. RSE simulation was performed on the collected profiles to simulate the RSE inspection. This consisted of driving a simulated 10-foot straightedge over the profile and calculating the tolerance at the mid-point of the straightedge. This was followed by calculating the Percentage Defective Length (%DL). The percent defective length is defined as the total length of the defects (areas that are greater than 1/8 inch in ten foot) divided by the total length tested times 100.

Statistical analysis was performed on statistical data in order to investigate the equipment repeatability and the variations among devices, including the two Rolling Straightedges. During this section, the effect of speed analysis was performed on the data collected using the light weight profilers and the high-speed profiler. The objectives at this phase were to correlate the RSE measurements with the results of the simulation analysis performed on the profiles measured during the automated devices.

HERE IS WHAT WE FOUND...

After evaluating the difference among the devices by comparing the %DL of all devices and sections, it was determined that the null hypothesis of no difference was incorrect. The differences among the devices/sections are significant at a 90% confidence level.

Differences between pairs of devices was established by comparing the average %DL of different pairs of devices for all sections. Results from the two-sided T-tests yielded a 90% confidence level in that differences between any two devices is significant.

Repeatability of each device was tested through comparison of repeated runs (pair-wise) for each section. It was determined that there was no significant difference in the results among repeated runs on each test section.

Finally, the speed effect on ARAN measurements was studied through comparing repeated runs at different speeds on each test section, resulting in concurrence that there would be no significant difference among repeated runs at varying speeds.

In conclusion, differences among %DL measured with different devices was found to be statistically significant, as is also true for IRI measurements. The variation between the two RSE devices is large enough that it should not be ignored. In general, the differences were found to be both significant and not consistent.

When compared, the two Rolling Straight Edge devices, RSE I and RSE II, demonstrate that RSE 1 always reads higher deviations than RSE II. This is true even though both were calibrated under the same conditions.

The ARAN measurements at all speeds are significantly different from the measurements of the RSE I and RSE II measurements. Similarly, the effect of speed on the IRI measured using ARAN, yields a difference as high as 50%.

WHAT IS THE NEXT STEP?

In order to pursue replacement of Rolling Straightedges with automated devices, more research is necessary. Further investigation would be to establish a panel rating survey and more detailed profile analysis, as well as use of a simulation model.

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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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