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16. Abstract

NOVACHIP™ was successfully constructed on two highways in the San Antonio District of the Texas Department of Transportation: US 281 and SH 46. A NOVACHIP™ friction course consists of a layer of hot-mix material placed over a heavy polymer-modified asphalt tack coat. The course thickness ranges from 10 to 20 mm. Layer thickness is typically 1.5 times the diameter of the largest stone. The French process, NOVACHIP™, is a new technology for Texas and the United States. This research study was created to provide a field evaluation and documentation of the process and resulting performance.

After three years of service, the NOVACHIP™ pavement surfaces are in excellent condition. NOVACHIP™ shows promise as a preventive maintenance treatment or surface rehabilitation technique for asphalt concrete pavements. It should provide the maintenance engineer with an alternative for chip seals, micro-surfacing, plant-mix seals, or thin asphalt concrete overlays.

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PERFORMANCE EVALUATION OF NOVACHIP™: ULTRATHIN FRICTION COURSE

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IMPLEMENTATION STATEMENT

The goal of this study was to conduct a thorough investigation of the NOVACHIP™ construction process and evaluate performance at regular intervals for a period of three years. This report is partial documentation of this goal: performance monitoring documentation. The construction process has been thoroughly evaluated and documented in Research Report 553-1.

Findings in the study indicate that the NOVACHIP™ pavement surface is a viable alternative to conventional pavement surfacings and offers some distinct advantages over conventional surfacings as described in the report. Performance of NOVACHIP™, as documented in this report, was excellent.

The researchers recommend implementation of NOVACHIP™ by the Texas Department of Transportation. Video footage was collected as part of this research effort and may aid the Department in the development of an instructional tool if desired.

NOVACHIP™ is now available in the U.S. Midland Asphalt in Tonawanda, New York and Highway Maintenance Systems in Whitehall, Pennsylvania have been licensed by the parent company Screg Routes of France. It is reported that more than one million square meters of NOVACHIP™ have been placed in the northeastern part of the U.S. in the last 3 years.

The cost of the NOVACHIP™ surface for this job was about $3.02 per square meter. Current prices for microsurfacing in Texas range from $.70 to $.95 per square meter. Depending on the type of binder used, chip seals range from $.60 to $.85 per square meter in cost, and thin overlays (25 mm) are about $1.80 per square meter. The selling price of NOVACHIP™ in France is reported to be the same as micro-surfacing and just a little more than a polymer modified asphalt chip seal.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Texas Department of Transportation (TxDOT) or Federal Highway Administration (FHWA). This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes.

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SUMMARY

NOVACHIP™, sometimes known as an ultrathin friction course, was successfully constructed on two highways in the San Antonio District of TxDOT. The French process, NOVACHIP™, is a new technology for Texas and the United States, and this research study was initiated by the Federal Highway Administration in cooperation with the Texas Department of Transportation to provide a means for evaluation and documentation of the construction process and performance of the resulting pavement surfaces.

The pavements to receive the NOVACHIP™ surfaces were evaluated prior to construction. This included visual performance evaluations and measurements of ride quality and skid resistance. Six kilometers of US 281 (four-lane divided highway) received the NOVACHIP™ treatment. A 3-km section of roadway adjacent to the south end of the US 281 construction project served as a control (untreated) section. Near the end of the study, the district resurfaced the control section with a microsurfacing. Fourteen kilometers of SH 46, which is a two-lane highway, was surfaced with NOVACHIP™.

After construction, the pavements were evaluated semi-annually and performance was documented. Frictional data were collected semi-annually, and ride quality was measured annually.

Performance results of the NOVACHIP™ were excellent. NOVACHIP™ is a viable preventive maintenance treatment or surface rehabilitation technique for asphalt concrete pavements. It should provide the maintenance engineer with an alternative to chip seals, microsurfacing, plant-mix seals, and thin overlays.

This research warrants implementation of NOVACHIP™ by the Texas Department of Transportation.

CHAPTER 1.0 INTRODUCTION

1.1 OBJECTIVE

The goal of this study was to conduct a thorough investigation of the NOVACHIP™ construction process and evaluate performance at regular intervals for a period of three years. The evaluation process was conducted in three distinct tasks which include (1) project initialization, (2) construction monitoring and documentation, and (3) follow-up monitoring, evaluation, and documentation. The first two tasks were documented in Research Report number 553-1 (Estakhri and Button 1993). This report documents the third task: follow-up monitoring, evaluation, and documentation.

1.2 BACKGROUND

The San Antonio District of the Texas Department of Transportation (TxDOT) included the NOVACHIP™ process on a surface rehabilitation project in Comal County (SH 46) and Bexar County (US 281) during October of 1992.

A NOVACHIP™ friction course consists of a layer of hot-mix material placed over a heavy, polymer-modified asphalt tack coat. The course thickness ranges from 10 to 20 mm, depending on the maximum size of the stone. Layer thickness is typically 1.5 times the diameter of the largest stone.

The hot-mix material is a gap-graded mixture and includes a large portion (70 to 80 percent) of single-sized crushed aggregate which is bound with a mastic composed of sand, filler (if needed), and asphalt binder. (Serfass et al. 1991). This mixture is sometimes described as "hot, coated chippings."

The binder content of the asphalt-aggregate mixture ranges from 5.3 to 6.0 percent. The heavy tack coat consists of a polymer-modified emulsified asphalt, and the application rate commonly varies between 0.7 and 1.0 liters per square meter.

NOVACHIP™ is placed with a specially designed paving machine which combines the functions of an asphalt distributor and a laydown machine. The paver applies the tack coat *and*

the hot asphalt mixture in a single pass. This heavy application of tack helps to ensure adhesion of the friction course to the underlying pavement and reduces the possibility of surface water intruding into the pavement substrate.

1.3 DESCRIPTION OF WORK

Pavements to receive the NOVACHIP™ surfaces were evaluated prior to construction. This included visual documentation of existing condition and measurements of ride quality and skid resistance. Six kilometers of NOVACHIP™ were evaluated on US 281. A 3-km section of roadway near the south end of the US 281 pavement served as a control throughout this study for US 281. Near the end of the study, the district resurfaced the control section with a microsurfacing. Fourteen miles of NOVACHIP™ were constructed and monitored on SH 46.

After construction, the pavements were evaluated semi-annually, and performance was documented. Frictional data were collected semi-annually, and ride quality was measured annually.

1.4 RESEARCH OUTCOME

Performance results of the NOVACHIP™ were excellent. NOVACHIP™ is a viable preventive maintenance treatment or surface rehabilitation technique for asphalt concrete pavements. It should provide the maintenance engineer with an alternative to chip seals, microsurfacing, plant-mix seals, and thin overlays.

This research warrants implementation of NOVACHIP™ by the Texas Department of Transportation.

2.0 PRESENTATION OF FIELD PERFORMANCE DATA

2.1 INTRODUCTION

The pavements to receive the NOVACHIP™ surfaces were evaluated prior to construction. A visual survey was conducted to document existing surface condition. Ride quality was evaluated using TxDOT's Siometer, and skid resistance was measured using the ASTM E274 skid trailer. Near the end of the study, the district resurfaced the control section using microsurfacing.

After construction, the pavements were evaluated semi-annually, and performance was documented. Frictional data were collected semi-annually, and ride quality was measured annually.

2.2 PRECONDITION SURVEYS

Prior to construction, precondition surveys were performed on US 281 and SH 46. An index of pavement condition has been described which quantifies all forms and levels of pavement distress (Epps et al. 1974). Based on maintenance costs, this index, or Pavement Rating Score (PRS), allows numerical comparisons of pavement condition. A PRS value of 100 describes a pavement with no distress. Progressively lower PRS values describe a pavement with more distress and/or greater distress severity.

US 281 was in good condition at the time of resurfacing. Pavement Rating Scores were obtained at several stations along the pavement, and US 281 had an overall PRS of 93 prior to construction. The surface was a double chip seal which was in relatively good condition. The primary types of distress observed were some slight to moderate flushing at isolated locations and slight ravelling.

At the south end of the construction project on US 281, a 3-km pavement section was chosen to serve as a control (no treatment) section. The pavement surface and cross-section was essentially the same as the pavement underlying the NOVACHIP™ surface. The overall average PRS value for the control section at the time of construction was 90.

The Pavement Rating Score for SH 46 prior to construction was 85. The primary surface distresses were longitudinal cracking and some slight ravelling. The cracks had been sealed the previous spring; however, at the time of the survey, they were observed to be partially sealed.

2.3 POST-CONSTRUCTION PAVEMENT EVALUATIONS

Visual performance evaluations revealed that the NOVACHIP™ surfaces exhibited very little to no distress during this 3-year evaluation period. Overall average Pavement Rating Scores throughout the evaluation period are shown in Figures 1 and 2 for the NOVACHIP™ and control surfaces.

2.4 FRICTIONAL CHARACTERISTICS

Skid resistance data was collected on the project using TxDOT's locked-wheel skid trailer (ASTM E 274). The skid unit travels at a constant speed with the left trailer wheel locking at periodic intervals on a wetted surface. Classes of skid numbers are shown below:

Skid Number	*Description*
50 - 100	Very Good
40 - 49	Good
30 - 39	Fair
20 - 29	Poor
1 - 19	Very Poor

Skid data for US 281 and the control are plotted versus time in Figure 3. Skid measurements taken prior to construction for both the control and NOVACHIP™ were in the lower 30s. Skid data collected throughout the remainder of the study revealed some variation in the NOVACHIP™ surface during the first year; however, the skid measurement leveled off to a value of about 45 throughout the remainder of the evaluation period.

The control section remained in the low 30s throughout the evaluation period until a new microsurfacing was placed on the control (in the last year), and its skid measurement was 60.

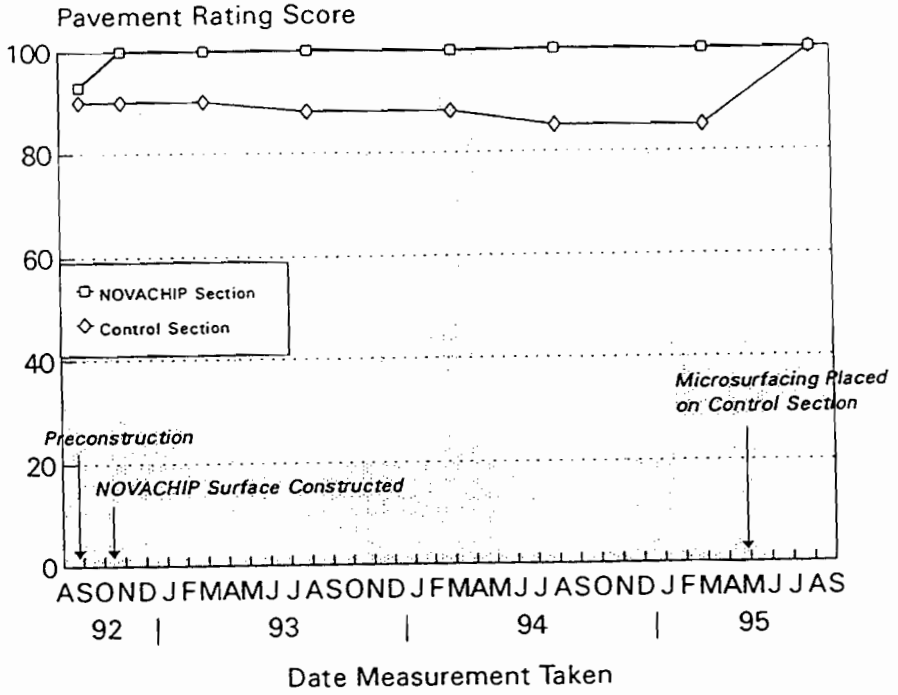

Figure 1. Average Pavement Rating Scores for US 281.

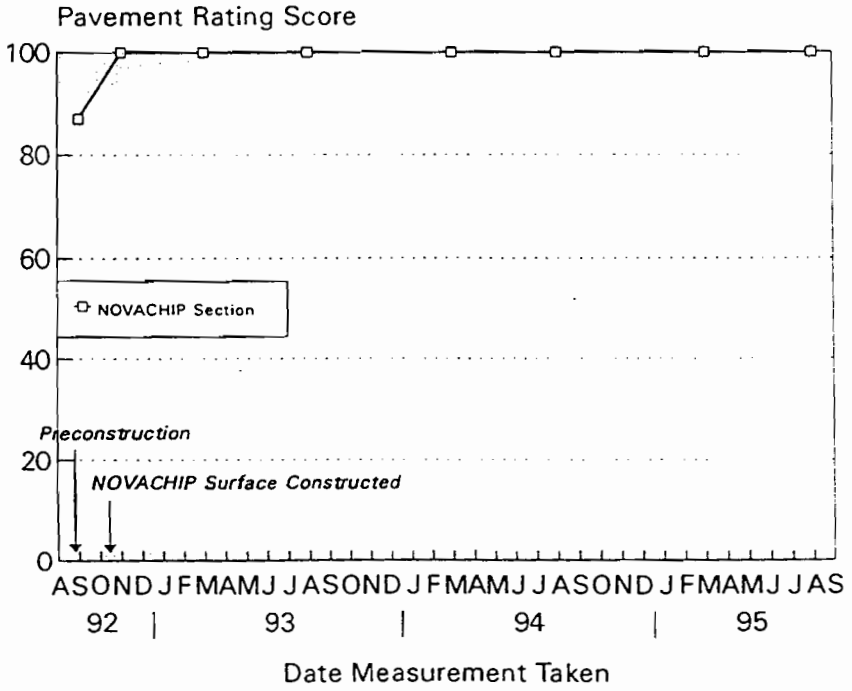

Figure 2. Average Pavement Rating Scores for SH 46.

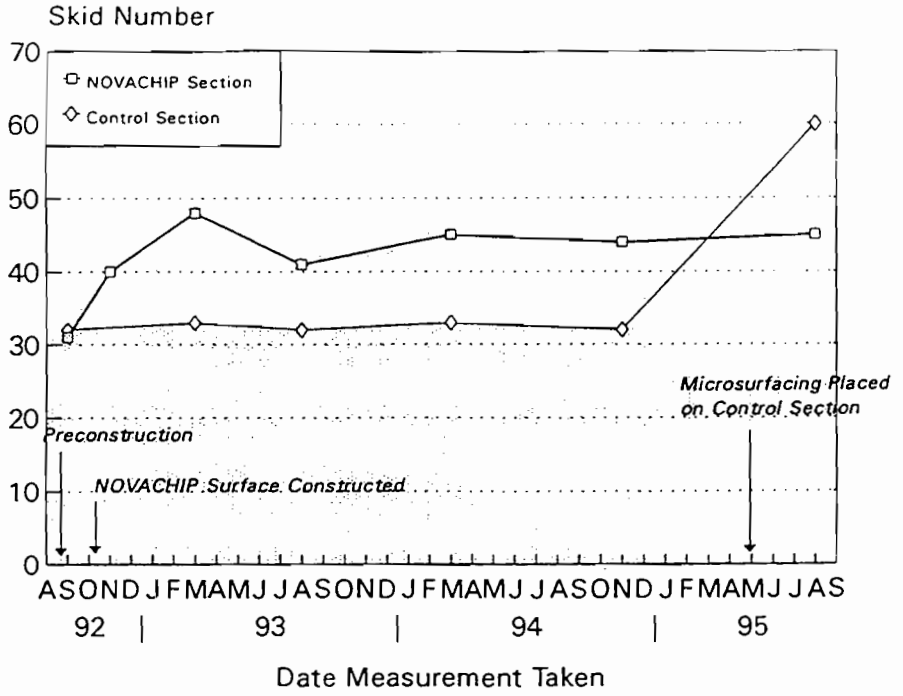

Figure 3. Average Skid Numbers for US 281.

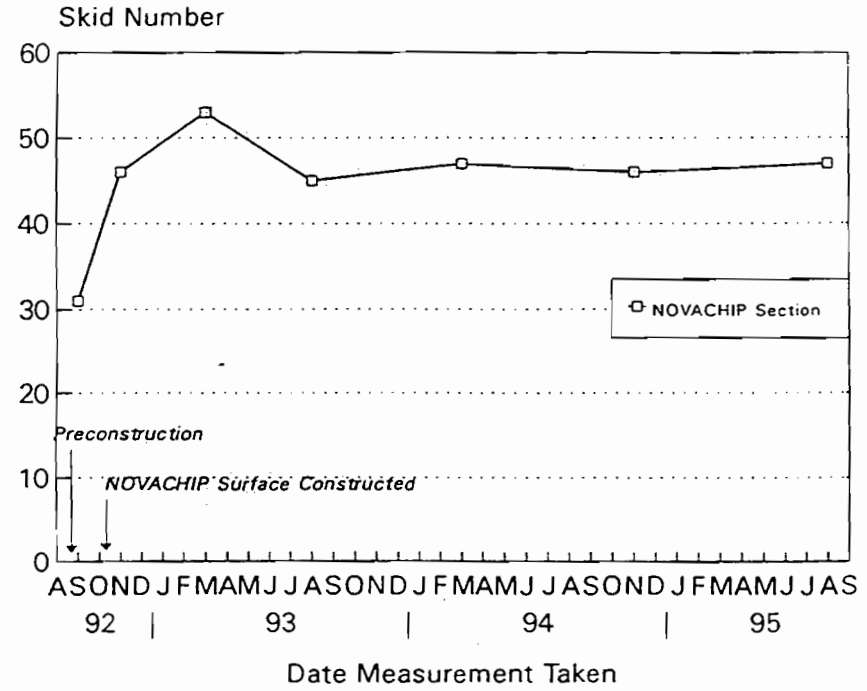

Figure 4. Average Skid Numbers for SH 46.

Skid data taken on SH 46 revealed that prior to construction, the surface had an average value of 31. After construction of NOVACHIP™, the average skid value was never below 46, as shown in Figure 4.

2.5 RIDE QUALITY TESTING

One of the claims to be investigated in this study was that NOVACHIP™ can be used to restore a pavement surface to a limited extent, e.g., rut-filling and smoothing corrugations and other surface irregularities. TxDOT's SIometer was used to measure the ride quality of the pavement before and after application of the NOVACHIP™ pavement surface. A SIometer has an accelerometer, a processing computer, and a data storage computer, all mounted in a vehicle. SIometer data are converted into a Ride Score based on a user panel rating, that ranges from 0.1 (very rough) to 5.0 (very smooth). Ride Score classes are shown below. A Ride Score below 3.0 indicates a rough road to the average person.

Ride Score	*Description*
4.0 - 5.0	Very Smooth
3.0 - 3.9	Smooth
2.0 - 2.9	Medium Rough
1.0 - 1.9	Rough
0.1 - 0.9	Very Rough

US 281 had an overall average ride score of 4.5 prior to construction which was excellent. SH 46 had a ride score of 4.0 prior to construction. As shown in Figures 5 and 6, the NOVACHIP™ surface improved the ride quality of both US 281 and SH 46; however, the preconstruction ride scores were so high there was little room for improvement. The microsurfacing placed on the control section in the last year of the study had a slightly lower ride score than the adjacent NOVACHIP™ pavement.

2.6 ADDITIONAL PERFORMANCE INFORMATION

Within the US 281 and SH 46 NOVACHIP™ pavements, several 36-meter test sections were chosen for more detailed pavement evaluation. Preconstruction crack maps

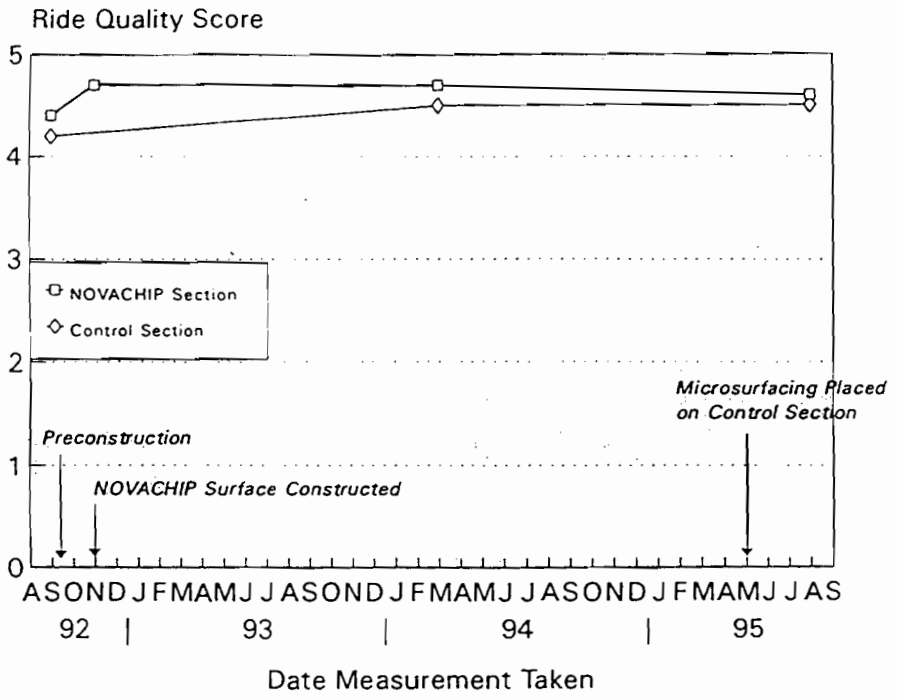

Figure 5. Average Ride Quality Scores for US 281.

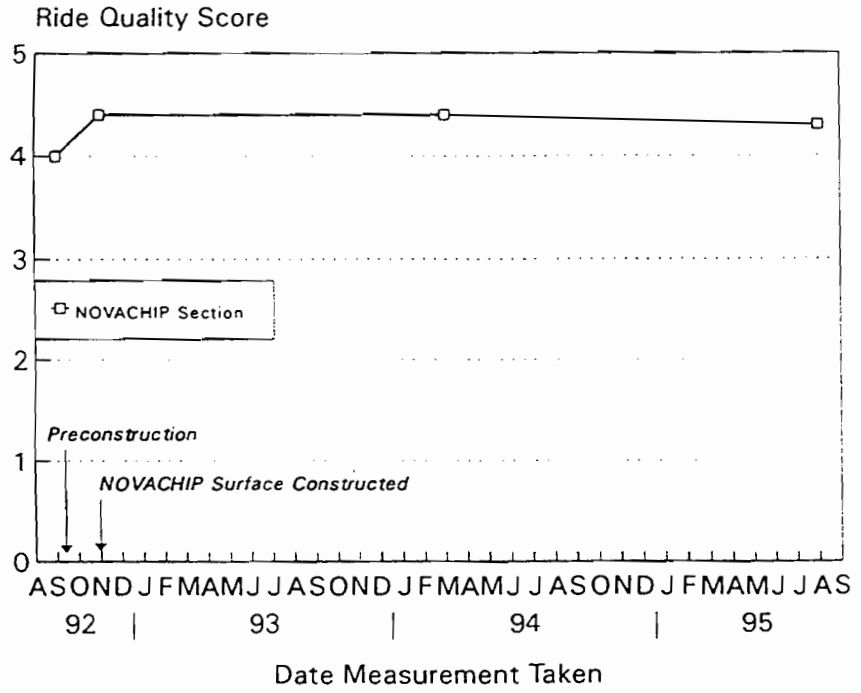

Figure 6. Average Ride Quality Scores for SH 46.

were developed for these sections, and a large number of photographs of these sections were taken throughout the study. After construction, close-up photographs were taken in a single location within each test section at each time of evaluation. This was to provide an objective evaluation of any progressive ravelling which might occur.

Throughout the performance evaluation period of this study, no distress was observed or measured in any of these NOVACHIP™ test sections.

It should be noted that, at the time these pavements were constructed, the State of Mississippi also constructed a NOVACHIP™ pavement section (Seshadri 1993). According to Mississippi DOT personnel, the NOVACHIP™ pavement section is performing very well and has maintained good skid resistance. They also report that the major barrier to the widespread use of NOVACHIP™ is its relatively high cost when compared to other surface rehabilitation techniques.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Two test pavements were placed in central Texas to evaluate the construction and early performance of NOVACHIP™. The following conclusions were reached regarding the performance of NOVACHIP™ based on the field evaluations:

- Field performance of NOVACHIP™ throughout this study was excellent. No significant distress was noted.
- NOVACHIP™ significantly increased the skid resistance of the pavement. NOVACHIP™ also had a higher skid resistance than the control (chip seal). However, a microsurfacing placed on the control in the last few months of the study had a higher skid resistance than the NOVACHIP™.
- A slight improvement in ride quality was observed with NOVACHIP™. It should be noted, however, the ride quality was excellent prior to surfacing with NOVACHIP™ , and there was not much margin for improvement.

Some of the advantages of NOVACHIP™ noted by the researchers are as follows:

- Excellent aggregate retention.
- Can reshape existing pavement to a limited degree (i.e., minor rut-filling, smoothing corrugations, and other minor surface irregularities).
- Suitable for use on high-volume pavements (no chip loss).
- Resistant to mat damage caused by turning and braking maneuvers.
- Can be reopened to traffic very quickly.
- Superior surface macrotexture.
- Strong adhesion to underlying surface which should minimize delamination.
- Low rolling noise characteristics (Serfass et al. 1991).
- Excellent sealing of old surface to prevent or minimize intrusion of surface water.

In the opinion of the researchers, an excellent application for the NOVACHIP™ process would be in urban areas and high-traffic volume areas where other preventive maintenance treatments such as chip seals or microsurfacings pose problems. Loose rock on chip seals is a major barrier to their use in urban and/or high traffic areas. Rolling noise can also be greater on chip seals. Microsurfacing is formulated with asphalt emulsion; therefore it cannot be reopened to traffic as quickly, which could be a drawback in some urban situations.

The researchers recommend the use of NOVACHIP™ as a skid-resistant surface layer. Based on the field construction part of this research, it appears that end-result specifications would best serve the Department with this type of surface treatment. It is recommended that end-result specifications with a warranty be considered. Cost-effectiveness could not be determined in this study since it was terminated before the end of the useful life of the surface.

Availability of NOVACHIP™ is somewhat improved in that at least two contractors in the United States have been licensed for the process: Midland Asphalt in Tonawanda, New York and Hiway Maintenance Systems in Whitehall, Pennsylvania. It is reported that more than one million square meters of NOVACHIP™ have been placed in the northeastern part of the US in the last 3 years.

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