Evaluation of Ultrathin Friction Course

CINDY K. ESTAKHRI AND JOE W. BUTTON

The French process, NOVACHIP, sometimes known as ultrathin friction course, is a new technology in the United States. NOVACHIP was successfully constructed on two highways in the San Antonio District of Texas. A research study was conducted by the FHWA, in cooperation with the Texas Department of Transportation to evaluate and document the NOVACHIP process and its performance. After 10 months of service, the NOVACHIP pavement surfaces are in excellent condition. They appear to be in essentially the same condition they were immediately after construction and will be monitored for 3 years and their performance documented. In general, NOVACHIP appears to have promise as a preventive maintenance treatment or surface rehabilitation technique for asphalt concrete pavements. It should offer engineers an alternative to chip seals, microsurfacing, open-graded friction courses, or thin asphalt concrete overlays.

The San Antonio District of the Texas Department of Transportation (TxDOT) used the NOVACHIP process on a surface-rehabilitation project in Comal County (US 281 and SH 46) during October 1992. The experimental installation was one of three in the United States; others were constructed by the state departments of transportation in Mississippi and Alabama. Because NOVACHIP is a new technology in Texas and the United States, this research study was initiated to evaluate and document the process and its performance.

BACKGROUND

The NOVACHIP process was developed in France in 1986 by Screg Routes and Travaux Publics and is currently marketed by that company. NOVACHIP has been used successfully in Europe. (*1*) NOVACHIP, sometimes called "ultrathin friction course," was developed for use in preventive maintenance or surface rehabilitation (*2*). Its primary function is to restore skid resistance and surface impermeability. The process appears promising for pavement surface rehabilitation and provides engineers with alternatives to chip seals, microsurfacings, plant-mix seals, or thin overlays.

Some of the advantages of NOVACHIP™, as indicated by the manufacturer, are

- Excellent adhesion (no chip loss),
- Reduced rolling noise (particularly for urban use),
- Rapid application,
- Quick reopening to traffic, and
- Reshaping of existing pavement (to improve drainage, ride quality).

NOVACHIP can be used as a surface seal for bituminous pavements to reduce deterioration caused by weathering, ravelling, traffic, and oxidation. It seals small, "nonworking" cracks and provides a wearing surface with excellent skid resistance. NOVACHIP also can be used to restore pavement-surface smoothness to a limited extent, for examples, to fill ruts and smooth corrugations and other surface irregularities. NOVACHIP does not increase the structural capacity of the pavement, however.

Description of NOVACHIP

A NOVACHIP friction course consists of a layer of hot-mix material placed over a heavy tack coat. The course thickness ranges from 3/8 to 3/4-in. (10 to 20 mm), depending on the maximum size of the stone. Layer thickness is generally about 1 1/2 times the diameter of the largest stone (*2*).

The hot-mix material is a gap-graded mixture that includes a large portion (70 to 80 percent) of single-sized crushed aggregate, bound with a mastic composed of sand, filler (if needed), and binder (*2*). The mixture is sometimes described as "hot, coated chippings."

The binder content ranges from 5.3 to 6.0 percent, depending on the traffic, climate, and peculiarities of the existing pavement, as determined by engineers at Screg Routes.

The heavy tack coat is generally a polymer-modified, emulsified asphalt, and the application rate commonly varies between 0.15 and 0.22 gal/yd^2 (0.7 and 1.0 L/m^2).

NOVACHIP is placed with a specially designed paving machine that 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 to reduce the possibility of surface water intruding into the pavement structure.

Description of Paving Equipment

Application equipment for the NOVACHIP process was designed to accommodate these operations (*1*):

- Collection of the mixture from the transport trucks,
- Storage of the mixture,
- Storage of sufficient tack emulsion for at least 3 hr of operation,
- Distribution of the tack coat with servo-controlled application rate,
- Immediate covering of the tack with the mixture,
- Smoothing of the applied mixture into a virtual monogranular layer, in relation to the two or three highest points of the existing pavement surface.

The NOVACHIP paving machine, as it was developed, includes the following components (*1*):

Texas Transportation Institute, TTI/CE Building, Suite 508, Texas A&M University, College Station, Tex. 77843-3135.

• Hopper for the collection of the mix and a coupling for attaching it to the hook of the truck supplying the mixture. The hopper's design was changed several times to prevent hot, coated chippings from sticking in the mixture. Because the chippings tend to stick to each other, their manipulation, storage, and collection is not easy. The hopper is fitted with two transfer screws.
• Screw or rake conveyor that lifts and feeds the mix into a hopper.
• Heated compartment to store the mixture, which has a total capacity of about 4 to 6.5 yd^3 (3 to 5 m^3).
• Heated tank for the tack binder (16 yd^3 or 12 m^3).
• Conveyor to transfer the mixture to the forward part of the smoothing assembly, where the mixture is deposited on the road surface.
• Spray bar to distribute the tack coat. Nozzles on the spray bar are at a large distribution angle and closely spaced. The transverse displacement of the spray bar is servo-controlled to ensure that the spray lines up with the boundary of the hot mix.
• Heated assembly for screeding the hot mix layer. The width of the screed can be varied from 8 to 15 ft (2.5 to 4.6 m^3).

PRECONSTRUCTION INFORMATION

Existing Pavement Cross Sections

Before construction, the pavement surface of US 281 consisted of a 7-year-old double chip seal: Grade 5 (No. 4 or 4.75 mm) over Grade 3 (½ in. or 12.5 mm). Underneath the double chip seal, most of US 281 is a 3-in. (75-mm) layer of hot-mix asphalt concrete on top of a Grade 3 (½ in. or 12.5 mm) surface treatment over 8 in. of flexible base, constructed in 1972.

SH 46 had been surfaced with a 1-in. (25-mm) thick layer of asphalt concrete pavement (ACP); it was about 8 years old at the time of the construction project. Cracks in the pavement surface had been sealed with asphalt-rubber crack sealant the previous spring. Under the ACP surface was a series of chip seals over a 1-in. thick layer of ACP. The lower layer of ACP had been constructed in about 1958. Under the lower ACP layer was the original pavement, laid in the mid 1930s and thought to be a double-surface treatment on a limestone base.

Limestone bedrock is at or very near the surface in this part of Texas; therefore, the subgrade for much of the region's pavement is a limestone bedrock, which provides excellent support.

Traffic Data

Traffic data on US 281 and SH 46 near the time of construction was provided by TxDOT as follows:

• US 281: weighted average daily traffic (ADT) = 20,300 vehicles per day (vpd), 6.0 percent trucks;
• SH 46: weighted ADT = 4,200 vpd, 6.4 percent trucks.

Precondition Surveys

Before construction, precondition surveys were performed on US 281 and SH 46. An index of pavement condition was used that quantifies all forms and levels of pavement distress (*3*). Based on maintenance costs, this index, or pavement rating score (PRS), allows numerical comparison of pavement conditions. A PRS value of 100 describes a pavement with no distress. Progressively lower PRS values describe pavement conditions that include more severe types of distress.

US 281 was in good condition before construction. PRSs were obtained at several stations along the highway and are illustrated in Table 1. US 281 had an overall PRS value of 93 before construction began. Its surface was a double-chip seal that was in relatively good condition. Primary types of distress observed included some slight to moderate bleeding in various places and slight ravelling.

SH 46 had an overall PRS of 85; its scores are shown in Table 2. Its primary surface distress was longitudinal cracking and some slight ravelling. Cracks had been sealed the previous spring; however, at the time of the survey, they were partially sealed.

US 281 Pavement Test Sections

For the NOVACHIP study, eight test sections were designated along US 281. The sections were 120-ft (36-m) long and chosen for more detailed pavement evaluation. Data collected on test sections

TABLE 1 US 281 Preconstruction Pavement Rating Scores

Station	Northbound Lanes Inside	Northbound Lanes Outside	Southbound Lanes Inside	Southbound Lanes Outside
730 + 00	95	85	93	90
710 + 00	95	95	95	90
690 + 00	100	92	100	92
670 + 00	95	95	95	85
640 + 00	100	95	95	85
620 + 00	100	88	100	85
600 + 00	100	85	100	92
580 + 00	100	85	100	85
560 + 00	100	88	100	85
540 + 00	100	88	100	88
526 + 85	100	88	100	88
AVG.	**99**	**89**	**98**	**88**

Grand Average 93

TABLE 2 SH 46 Preconstruction Pavement Rating Scores

Station	Eastbound Lane	Westbound Lane
1060 + 00	88	88
1030 + 00	88	88
1000 + 00	83	83
970 + 00	83	73
940 + 00	83	88
910 + 00	88	88
880 + 00	88	92
850 + 00	88	78
820 + 00	88	85
790 + 00	89	81
760 + 00	90	83
730 + 00	90	83
700 + 00	90	90
670 + 00	90	93
640 + 00	90	90
610 + 00	88	88
580 + 00	88	90
AVG.	**88**	**86**

Grand Average 87

before construction of the NOVACHIP surface consisted of visual evaluations, photographs, rutting measurements, and surface-texture measurements.

A 2-mi (3.2-km) section of US 281, beginning at the south end of the NOVACHIP project site, served as a control section; it received no treatment and was monitored throughout the process. The pavement surface and cross section at the control site was in essentially the same condition as pavement that would be constructed with the NOVACHIP surface.

SH 46 Pavement Test Sections

Seven 120-ft (36-m) test sections were designated on SH 46 within the scope of the NOVACHIP project. In addition to the types of data collected on US 281, crack maps of the SH 46 test sections were prepared. Crack maps were unnecessary for US 281, because no cracking had been observed.

Ride-Quality Data

One of the claims to be investigated was that NOVACHIP could be used to restore pavement-surface smoothness to a limited extent, that is used for rut-filling and to smooth corrugations and other surface irregularities. TxDOT used a SIometer to measure the ride quality of the pavement surface both before and after NOVACHIP was applied. A SIometer has an accelerometer, processing computer, and data-storage computer mounted in one vehicle. The SIometer's data are converted into a ride score on the basis of a user-panel rating that ranges from 0.1 (very rough) to 5.0 (very smooth). Ride score classifications are shown in the in-text table. A road with a ride score below 3.0 is experienced as a rough one by 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

Before construction, US 281 had an overall ride score of 4.5, and SH 46 had an average ride score of 4.0.

CONSTRUCTION

Construction of the NOVACHIP pavement surface on US 281 began October 15, 1992, and the SH 46 job was completed on October 31, 1992. Weather was favorable during construction; morning temperatures usually were around 65°F (18°C), and afternoon highs of about 85°F (30°C). Skies were clear to partly cloudy, and the wind was calm at about 20 mph (32 km/hr).

Specifications

Certain specification requirements for the NOVACHIP mixture are somewhat more stringent than what is normally required in Texas for hot-mix asphalt concrete.

Materials

The NOVACHIP process requires that coarse aggregate in the mix be a high-quality, 100 percent crushed material. Coarse aggregate (plus No. 10 or 2.0 mm) must have a polish value of more than 35. This requirement eliminates many of the aggregate sources in

Texas. The Los Angeles Abrasion Test loss must be less than 35 percent, and the magnesium-sulfate soundness test loss must not exceed 25 percent.

The fine aggregate (minus No. 10 or 2.0 mm) must also be 100 percent crushed material. It must be supplied from a source where coarse aggregate meets the Los Angeles abrasion and magnesium sulfate soundness loss requirements just detailed. It must also have a sand-equivalent value of 60 or more.

Asphalt material used for the paving mixture must meet TxDOT standard specifications for AC-20.

Paving Mixture

A NOVACHIP contractor must provide the mixture design for the project.

Specification Changes Before Construction

At a preconstruction conference, October 13, 1992, it was revealed that the aggregate that was to be used for the mixture did not meet the specifications. The aggregate did not meet specification on the No. 4 (4.75 mm) and No. 40 (425 μm) sieve and was very close to the lower end of the specification limits on other screens. Its sand equivalent value, also out of specification, was measured at 54 instead of 60 or below, as required.

Screg Routes engineers at the meeting stated that it was paramount that the percent retained on the No. 10 (2.0 mm) sieve be below 75 and the percent passing the No. 200 (75μm) sieve be a minimum of 5.5. They said that the above gradation and the sand equivalent value of 54 were acceptable for the NOVACHIP process.

A fundamental objective was to provide an opportunity for Screg Routes to showcase the NOVACHIP pavement in the United States; therefore, TxDOT engineers decided that if the material properties of the aggregate were acceptable to Screg Routes, specifications would be changed to reflect this. Their changes to the mixture gradation specifications are shown in Figure 1. The sand-equivalent specification was changed from a minimum value of 60 to a minimum value of 50.

Job Materials

US 281

The coarse aggregate for US 281 was a traprock (basalt) provided by Vulcan Materials from its plant in Knippa, Texas. The traprock is a very hard, durable, dark-colored aggregate with a polish value of 38. The fine aggregate used on the job consisted of dry, limestone screenings from Gifford Hill. The aggregate portion of the NOVACHIP mix was made up of 68 percent of the coarse traprock aggregate and 32 percent of the dry, limestone screenings.

The design asphalt content was 5.0 percent of an AC-20 grade. A liquid antistripping agent (PERMATAC) was also used at a rate of 0.5 percent by weight of the binder.

SH 46

TxDOT engineers, material suppliers, and contractors decided that the existing supply and projected production rate of the traprock was insufficient to yield enough mix to keep up with the paving machine for construction on SH 46. According to the rock supplier, the gradation was difficult to produce and cut production rates 50 percent.

For SH 46, a new design mixture was developed by Screg Routes engineers, which contained 34 percent traprock, 34 percent limestone from Helotes, and 32 percent dry limestone screenings. The asphalt content was increased to 5.3 percent.

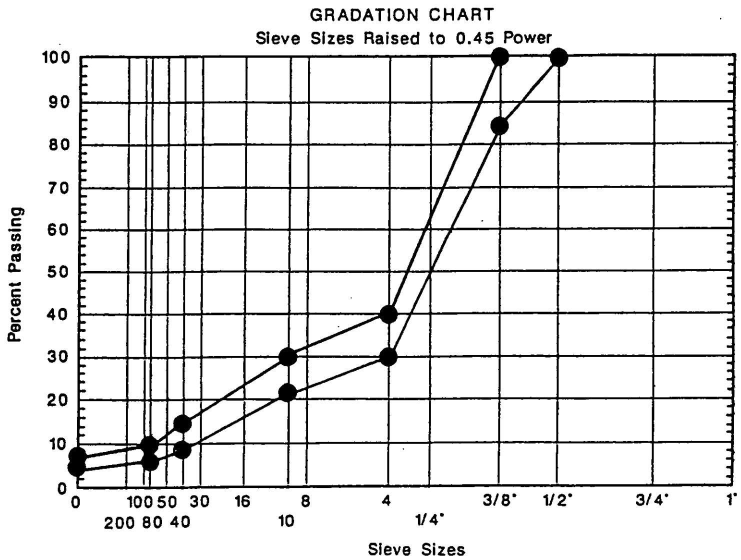

FIGURE 1 NOVACHIP aggregate gradation job specification limits.

Tack Coat

The tack coat was a polymer-modified emulsion designated CRS-2p. It was to be applied at a design-application rate of 0.20 gal/yd ^{2}.

Construction Sequence (US 281 and SH 46)

Before placement of the NOVACHIP, traffic buttons were removed from the existing pavement and the pavement surface was broomed. The NOVACHIP paving machine is capable of applying the tack coat and the paving mixture in one pass, and a nurse truck was used to periodically fill the NOVACHIP emulsion tank with the CRS-2p. Trucks transported hot-mix material from the drum-mix plant, which was approximately 10 mi (16 km) from the US 281 job and 20 mi (32 km) from the SH 46 job. Trucks backed up to the paving machine and dumped the mix into the hopper located at the front of the NOVACHIP paver, and the hopper augured the mixture to the back of the paver from which it was released onto the pavement. The tack coat was applied to the pavement about 2 sec before the mix was placed.

Two 10-ton (9-metric ton), steel-wheel rollers (66 in. or 1.7 m wide, and 54 in. or 1.4 m wide) made a total of 4 passes. The first roller ran immediately behind the paver. Traffic resumed on US 281 about 4 hr after construction, and on SH 46 it resumed about 2 hr after completion.

During construction on US 281, lanes were closed. On SH 46, pilot vehicles were used to control traffic.

The hot-mix plant operated at a temperature of 315°F (157°C), although Screg Routes engineers preferred that it operate at 330°F (165°C). Whereas the higher temperature improves workability of this harsh mixture, it was not possible to operate the plant at 330°F (165°C) and stay within the U.S. air-quality limits.

Construction Notes: US 281

US 281 is a four-lane, divided highway. Construction of US 281 began on Thursday, October 15, 1992, and included approximately 4 mi (6.5 km) of highway, or a total of 16 lane mi (26 km). Construction was completed in four working days. Production rates and job yields are shown in Table 3.

Construction of US 281 went very well, with the exception of a few minor problems. The most notable can be attributed to the equipment. Whenever the paving machine was stopped for any length of time on the pavement, the distributor nozzles continued to leak emulsion, causing excessive puddling. Sometimes the excess emulsion was washed off the pavement but often it was paved over. TxDOT engineers were concerned that the excess emulsion would eventually lead to a flushed surface in these areas. After the second day, the equipment was repaired.

Another problem occurs when the paver is stopped for an extended time period. Generally, there are two reasons to stop a paver during construction: to wait for a new load of hot-mix or to refill the emulsion tank on the paver with tack material. Where the paver was stopped for an extended period on US 281, there are very slight humps in the NOVACHIP surface that are noticeable when one passes over them at normal driving speed. When the paver was stopped, apparently the mix in front of the screed cooled excessively, which caused the screed to ride up over the mix, leaving a slight hump in the mat.

Construction Notes: SH 46

SH 46 is a two-lane highway. Construction of SH 46 began in the eastbound lane on Wednesday, October 21, 1992, and included approximately 9.5 mi (15 km), or a total of 19 lane mi (30 km), plus several climbing lanes dispersed along that length. Its main travel lanes SH 46 were constructed in six working days, and another three days were devoted to constructing the climbing lanes. Production rates and job yields for the main travel lanes are shown in Table 4.

The eastbound lane of SH 46 was constructed without incident; however, problems began to develop with the mix during the construction of the westbound lane, including excessive tearing of the mat. Material appeared to be building up in front of the screed and then dragging along the pavement, causing tears in the mat from 6 in. (150 mm) wide to 4 ft (1.2 m) wide. A significant amount of handwork was necessary to repair the mat. Because the NOVACHIP mixture is 100 percent crushed material and lacks workability, it does not lend itself to handwork.

The problem of tearing in the mat persisted for two days, before the problem was resolved. The problem was attributed to the variability of the dry screenings. Only a half-day's supply of screenings were on hand throughout this period, so the stockpile was changing constantly, making quality-control testing of the stockpile difficult.

Screg Routes engineers redesigned the mixture, replacing the dry screenings, 32 percent of the aggregate portion, with 22 percent dry screenings and 10 percent washed screenings. This adjustment solved the tearing problem, and the remainder of the job was completed without difficulty.

In numerous places where the mat had required handwork, however, an unattractive blemish remained visible on the pavement

TABLE 3 US 281 Job Production Rates

Date	CRS-2p Tack Rate, l/m^2	Mix Produced, metric tons	Area Paved, m^2	Yield, kg/m^2
10/15/92 Th.	0.91	754	21,529	34.9
10/16/92 Fr.	0.82	1133	33,722	33.3
10/19/92 Mn.	0.73	983	27,376	35.7
10/20/92 Tu.	0.82	740	21,372	34.5

1 l/m^2 = 0.22 gsy
1 kg/m^2 = 1.83 lb/yd^2
1 m^2 = 1.2 yd^2
1 kg/m^2 = 1.83 lb/yd^2

TABLE 4 SH 46 Job Production Rates

Date	CRS-2p Tack Rate, l/m^2	Mix Produced, metric tons	Area Paved, m^2	Yield, kg/m^2
10/21/92 W.	0.77	523	17,503	29.7
10/22/92 Th.	0.82	753	21,658	34.6
10/23/92 Fr.	0.82	770	25,179	30.5
10/26/92 Mn.	0.96	670	19,228	35.9
10/27/92 Tu.	0.21	443	12,558	35.1
10/28/92 W.	0.19	728	16,900	35.7

1 l/m^2 = 0.22 gsy
1 kg/m^2 = 1.83 lb/yd^2

1 m^2 = 1.2 yd^2
1 kg/m^2 = 1.83 lb/yd^2

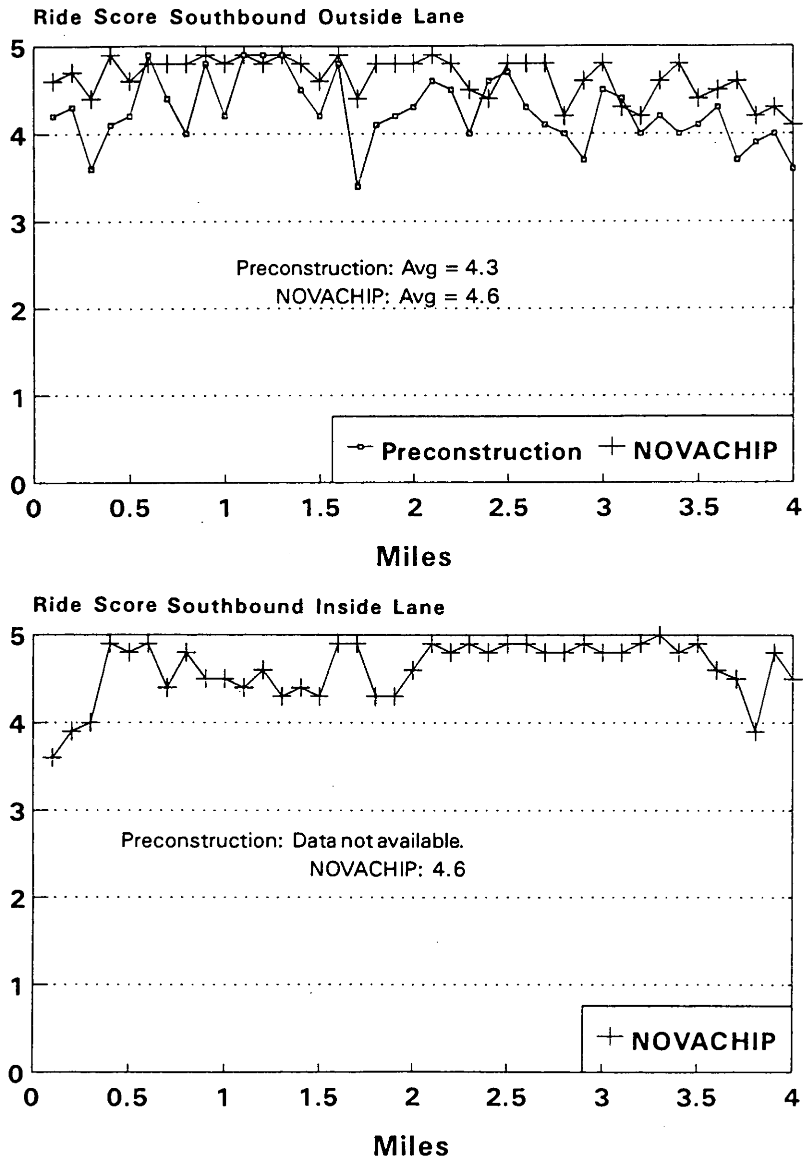

FIGURE 2 US 281 ride quality data for southbound lanes.

surface and was also noticeable from slightly rougher ride quality in these areas. Although the engineers hoped that these blemishes would fade with time and as the road was trafficked 10 months after construction, the blemishes were still evident.

Comments and Opinions of Engineers on Site

Comments of engineers visiting the construction site follow:

TxDOT Area Engineer: "For a pavement where I am very concerned about sealing the surface from the intrusion of water, the NOVACHIP pavement appears to be a good choice."

FHWA Engineer: "I am pleased with the way the NOVACHIP pavement looks, but the real issue is life-cycle cost. It has its place, but I'm not yet sure where—maybe in urban areas. I would like for NOVACHIP to be a success in this country, so that we have more paving options available to us."

FHWA Engineer: "NOVACHIP pavement looks very good—it's a very tough-looking mix. The NOVACHIP paving operation appears to be a lot quicker than a laydown machine. NOVACHIP may be a good alternative to microsurfacing, as there is no waiting time to allow traffic on surface. This pavement surface would be good to use anywhere ride quality and frictional characteristics need improvement."

EARLY PERFORMANCE

In August 1993 the NOVACHIP pavement surfaces on US 281 and SH 46 were evaluated for performance. They appeared to be in excellent condition—essentially the same condition as immediately after construction.

Ride Quality

Ride-quality measurements were made at the project sites before construction began and again 3 weeks later. The data for US 281 are shown in Figures 2 and 3. Before construction, US 281 had an ex-

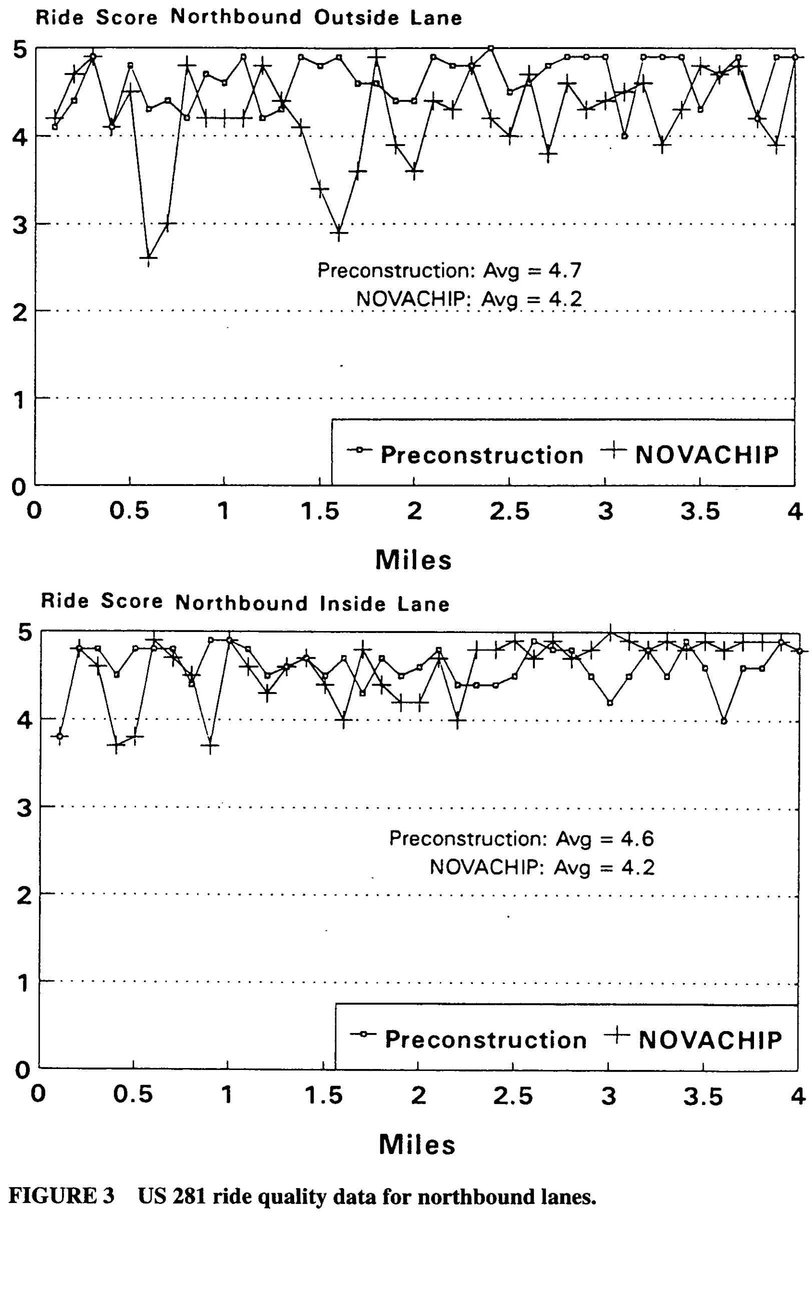

FIGURE 3 US 281 ride quality data for northbound lanes.

cellent overall average ride score of 4.5. After NOVACHIP surface construction, the overall average ride score again was 4.5, that is, no additional improvement in ride quality was detected.

Ride quality data for SH 46 is shown in Figure 4. The average ride score for SH 46 before construction was 4.0. After the NOVACHIP surface was laid the ride score improved; it measured 4.4.

Frictional Characteristics

Skid resistance data were collected using TxDOT's locked-wheel skid trailer (ASTM E274, ribbed tire). 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 (as described by TxDOT as part of their Pavement Management System) are shown in the in-text Table

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

Skid resistance data also were obtained from the district site before construction of the NOVACHIP surfaces in May 1992. The average skid number for both US 281 and SH 46 was 31. (See Figures 5 and 6.)

After NOVACHIP construction, skid data were collected again on November 17, 1992. The skid number for US 281 increased to 40 and for SH 46 the number increased to 46.

When skid data were collected again on March 17, 1993, the NOVACHIP surface of US 281 had a skid number of 48 and SH 46

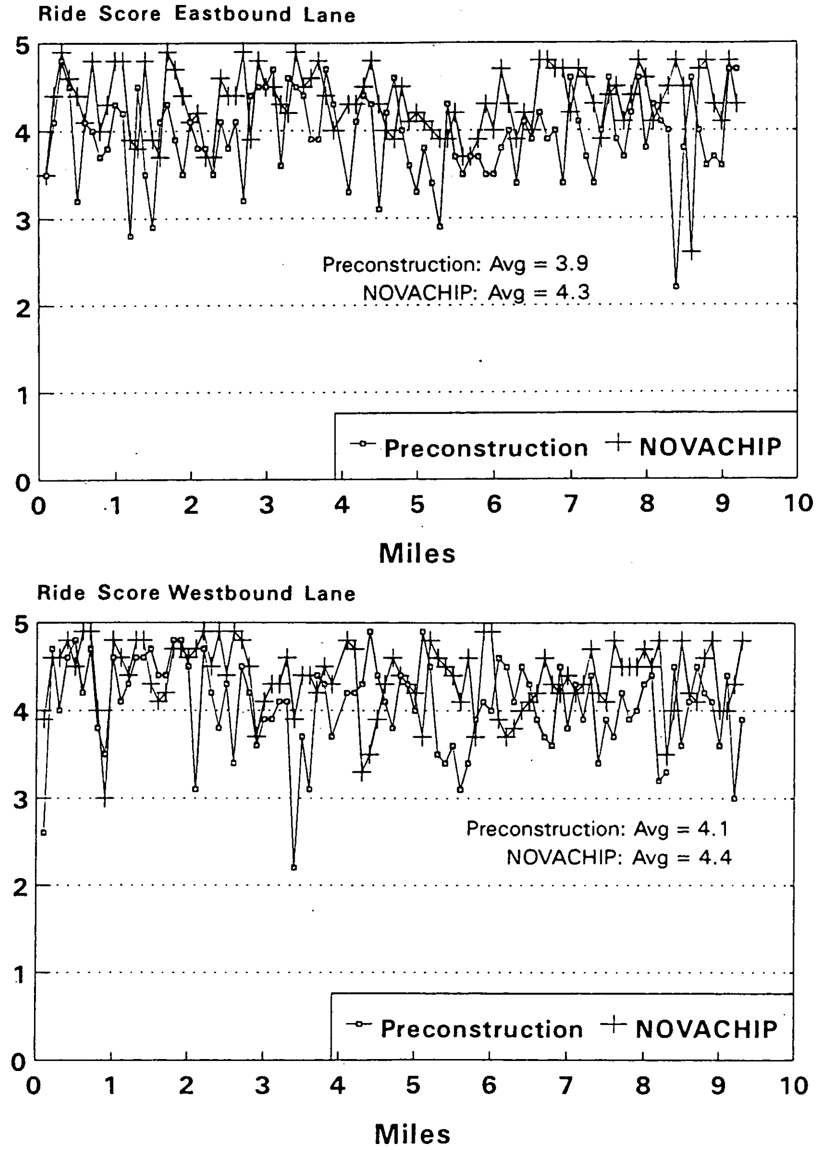

FIGURE 4 SH 46 ride quality data.

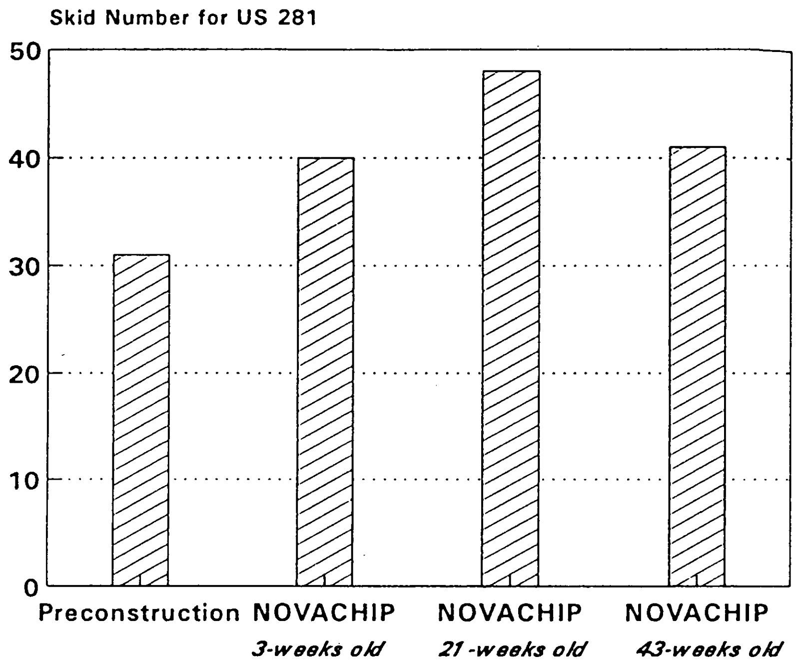

FIGURE 5 US 281 skid resistance data.

had a skid number of 53. The increase in skid resistance soon after construction probably results from traffic and weather wearing away or eroding the asphalt binder on the aggregate surface.

SUMMARY AND GENERAL COMMENTS

NOVACHIP was constructed successfully on two highways, US 281 and SH 46 in Bexar County, in the San Antonio District of TxDOT. The French process, NOVACHIP, is a new technology for the United States, and this research study was conducted to evaluate and document the process and its performance.

After one year of service, the NOVACHIP pavement surfaces are in excellent condition. The pavements appear to be in essentially the same condition they were immediately after construction. The pavements will be monitored for 3 years and their performance will be documented.

Because so few NOVACHIP jobs are constructed in the United States, the cost of the two projects was excessive. Equipment had to be transported to the United States from France to perform the two

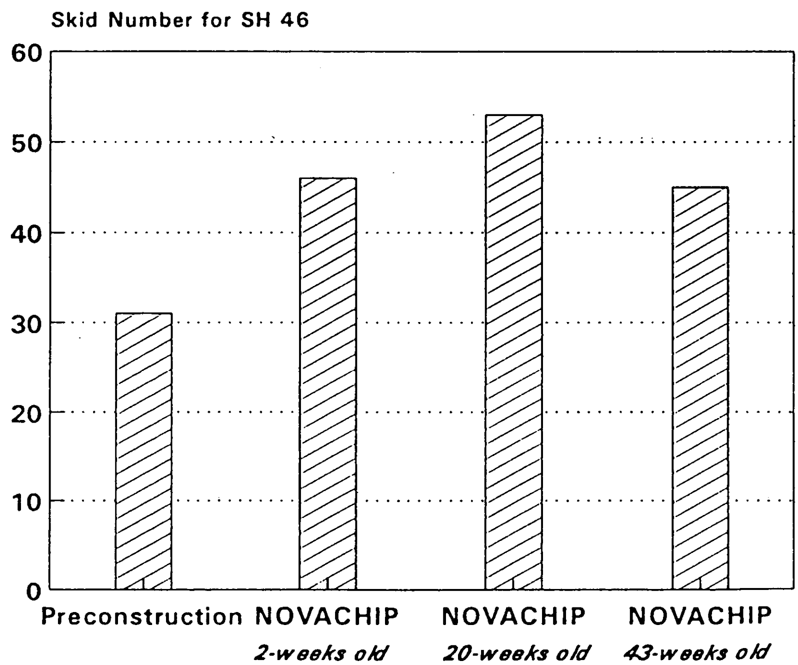

FIGURE 6 SH 46 skid resistance data.

jobs on a demonstration basis. In France NOVACHIP is reported to cost the same as microsurfacing and just a little more than a polymer-modified-asphalt chip seal.

In general, NOVACHIP appears to have promise as a 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, or thin asphalt concrete overlays. This study cannot directly compare NOVACHIP with other maintenance treatments, because no comparable test sections were constructed using other maintenance treatments. Some advantages NOVACHIP may have over these maintenance treatments were determined subjectively by the authors although they are not quantified in the study.

- Advantages Over Chip Seal
  –Excellent chip retention,
  –Ability to reshape existing pavement to a limited degree by filling ruts and smoothing minor surface irregularities,
  –Less rolling noise (a factor not measured in this study),
  –Suitability for use on roads with high traffic volumes, and
  –Greater resistance to surface damage caused by vehicles turning and stopping.
- Advantages Over Microsurfacing
  –Quick reopening of the constructed road to traffic,
  –Better adhesion to underlying surface with use of heavy tack coat,
  –Greater surface macrotexture, and
  –Better drainage—reduced splash and spray with the open surface texture.
- Advantages Over Open-Graded Friction Courses
  –Better adhesion to underlying surface with use of heavy tack coat, and
  –Better protection of underlying pavement from surface water, a typical problem with open-graded friction courses.
- Advantages Over Dense-Graded Thin Overlay
  –Better adhesion to underlying surface with use of heavy tack coat,
  –Rut-resistance with use of high-quality crushed materials,
  –Greater surface macrotexture,
  –Improved surface drainage, and
  –Better protection of underlying pavement from surface water.

Some preliminary conclusions regarding NOVACHIP from on-site observation and early performance data follow.

- NOVACHIP is a high-quality mixture, consisting of 100 percent crushed materials. The type of mixture, however, does not lend itself to a significant amount of handwork and raking.
- It is important that the mixture be at 280°F (138°C) or above when it is placed. Because of the openness of the aggregate gradation, the mixture loses heat quickly. If the mixture gets too cool, the paver must operate at a slower speed than is optimal. Excess mixture may also back up in front of the screed, causing tears in the mat that are not as easy to repair with this mix as with dense-graded hot mix. The plant temperature should be 315°F (157°C) or more. Trucks that are transporting the mix should be covered with tarps, if possible.
- NOVACHIP significantly increased the skid resistance of the treated pavement.
- No improvement in ride quality was measured on US 281 after NOVACHIP construction; however, existing pavement already had a very good ride score. However, ride quality was improved on SH 46; its ride score increased from 4.0 to 4.4.
- Quality-control procedures used for conventional hot-mix asphalt concrete jobs may not be acceptable for NOVACHIP. The mixture is noticeably sensitive to changes in mixture proportions. Instead, a performance-based specification on workmanship quality might be appropriate for NOVACHIP surfacing.
- NOVACHIP provides a uniform, attractive appearance but the mixture lacks workability. Therefore, excessive handwork and raking of the mix is very noticeable and detracts from the pavement's appearance and sometimes the ride quality. However, raking is necessary when the paving proceeds as it should.

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