TEXTURING OF CONCRETE PAVEMENTS

(Interim Report No. 1)

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SYNOPSIS

During the month of June 1973 the concrete surface of a section of Interstate 10 in the Baton Rouge area was textured using several different texturing techniques, such as burlap drag, brooms and metal tines. The purpose of this experimental research project is to learn which will perform the best in regard to skid resistance, nonhydroplaning properties, durability and uniformity. In June 1979, five years after the roadway will have been opened to traffic, the final evaluation of the textured sections will be performed.

Preliminary investigations indicated the following observations and recommendations:

1. Generally, skid numbers for the broom and metal tine experimental textures were higher than those for the burlap drag texture, which was specified in the Louisiana Department of Highways Standard Specifications and extensively used throughout the State.

2. Metal tines, preceded by heavy burlap drag and applied transversely to the centerline of the concrete pavement, produced grooves 1/8 to 3/16 inch deep with the highest skid number, the lowest speed gradient, and a noise level comparable to that of the normal burlap drag. As a result of the favorable data gathered on this study, this texturing technique has been adopted by the Louisiana Department of Highways as standard on all concrete pavements and bridge decks.

3. The extra heavy nylon broom was capable of producing a texture with high initial skid number, but the time of finishing was so critical that a uniform texture could not consistently be obtained. In addition, the researchers anticipate that the broom finish will have a wear rate greater than that of the tined finish.

4. None of the experimental textures produced objectionable road noise or increased the noise level significantly over normal burlap drag.

5. Accident data at this time is very meager and is inconclusive.

INTRODUCTION

Prior to this research study, the Louisiana Department of Highways Standard Specifications required that the final finish for concrete pavements be produced by a longitudinal burlap drag and that the resulting finish be reasonably free of grooves over 1/16 inch in depth. It became apparent from skid data obtained that this technique, when used to finish modern slip form paving construction, would not result in a long-lasting skid resistant surface. A very stiff mix is required for slip form paving, and the simple burlap drag did not produce the surface macrotexture needed for skid resistance wear longevitity under increasing traffic volumes.

It was necessary for new texturing methods to be found that would provide an initial high skid resistant textured surface for slip form paving which would last a long period of time. The Georgia Department of Transportation and the Texas Transportation Institute were contacted for texturing information, since they had constructed experimental sections using the mechanical tining technique. Their input has been most valuable in the development of this study, and several of their texturing methods were adopted and used on this study's test sections, which are located on Interstate 10 in Baton Rouge, Louisiana.

The purpose of this research study is to evaluate selected concrete textures for uniformity, wet roadway properties, and skid resistance durability.

SCOPE

The scope of this report is to describe the results obtained during the first twelve-month period of this field research project. It includes the construction of test sections and the evaluation period after the project was opened to traffic. Each test section was evaluated using the following techniques:

A. Visual Observation
B. Skid Resistance Measurements
C. Sand Patch Method for Determining the Texture Depths
D. Noise Level Measurements
E. Accident Data

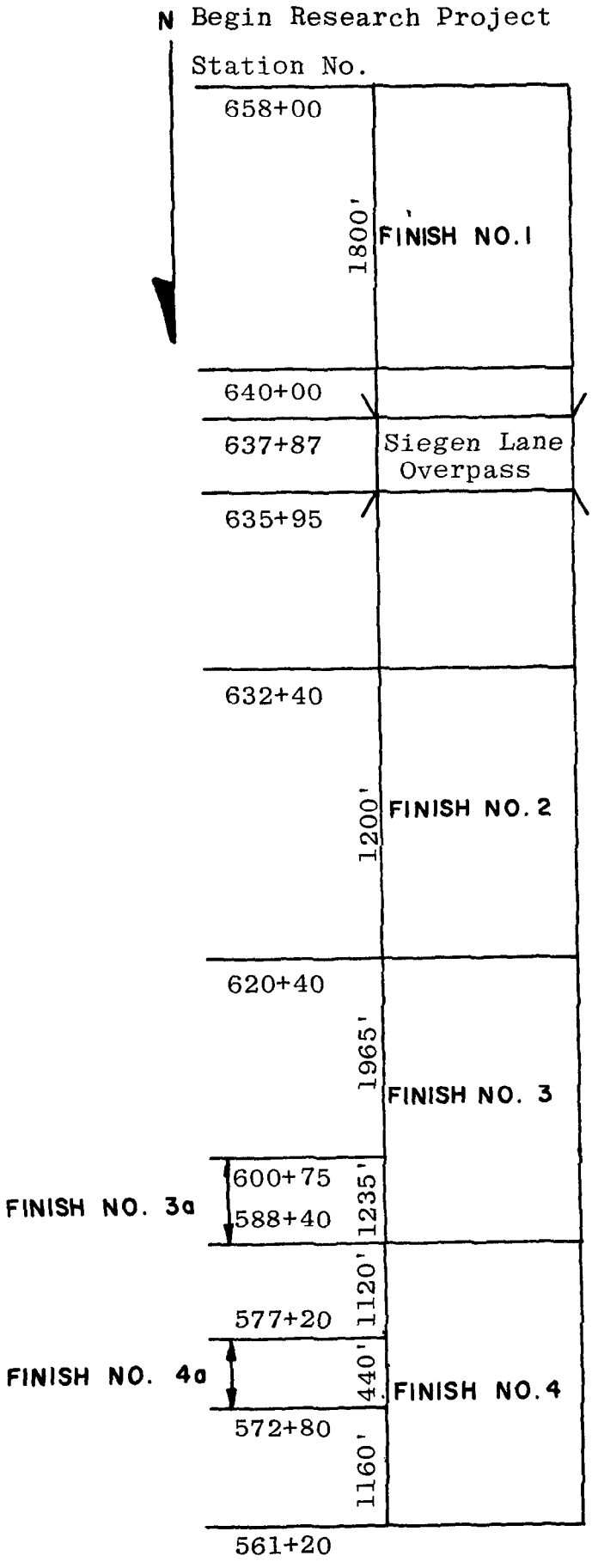
METHOD OF PROCEDURE

A portion of State Project No. 450-10-19, Federal Aid Project No. I-10-3(51)160, was selected as the site of the test installations. That project was located immediately south of Baton Rouge, Louisiana, on Interstate 10 between the College Drive and Siegen Lane intersections. The project was contracted to the T. L. James Construction Company to construct the selected surface finishes onto a 10-inch, jointed, unreinforced concrete pavement. Eight different surface textures were constructed using a CMI Autograde Texturing Finisher machine. Figures 1a, 1b, and 1c map the location of each test section listed in Table 1.

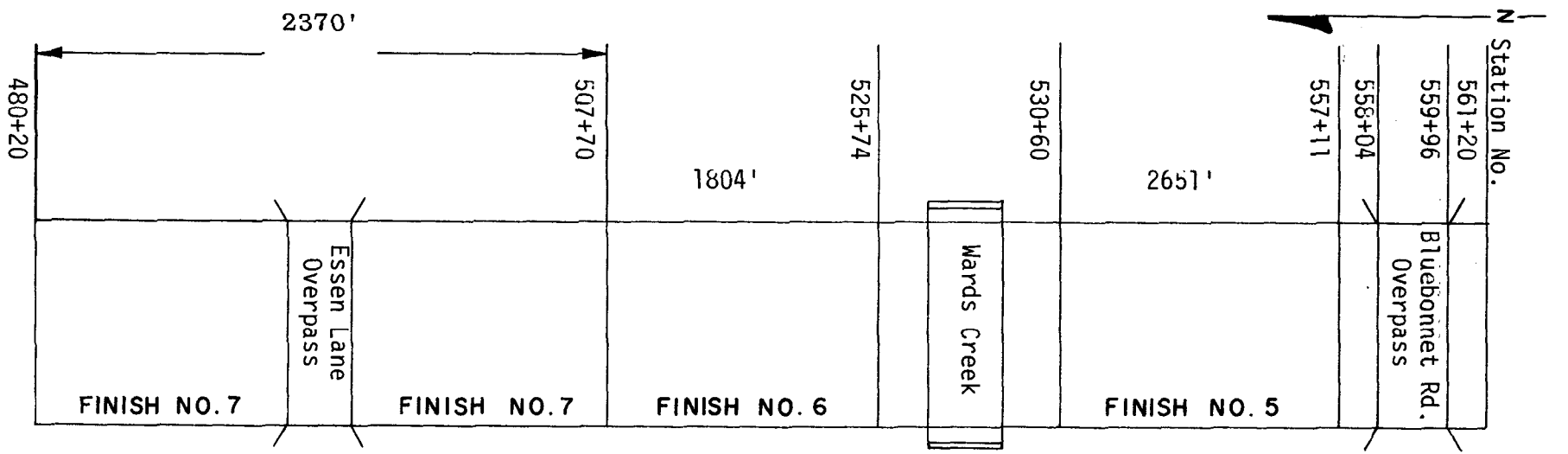
It was originally proposed that surface finishes using a burlap drag with tag ends and burlap with 60p trailing nails also be included in the study. However, attempts to use these methods did not prove successful; therefore they were dropped from the study as being inconsistent in their ability to provide a sufficient texture depth with the stiff concrete mix which was used.

The experimental textured sections were completed in June, 1973, and construction traffic used the roadway until May, 1974, when the highway was officially opened to the public.

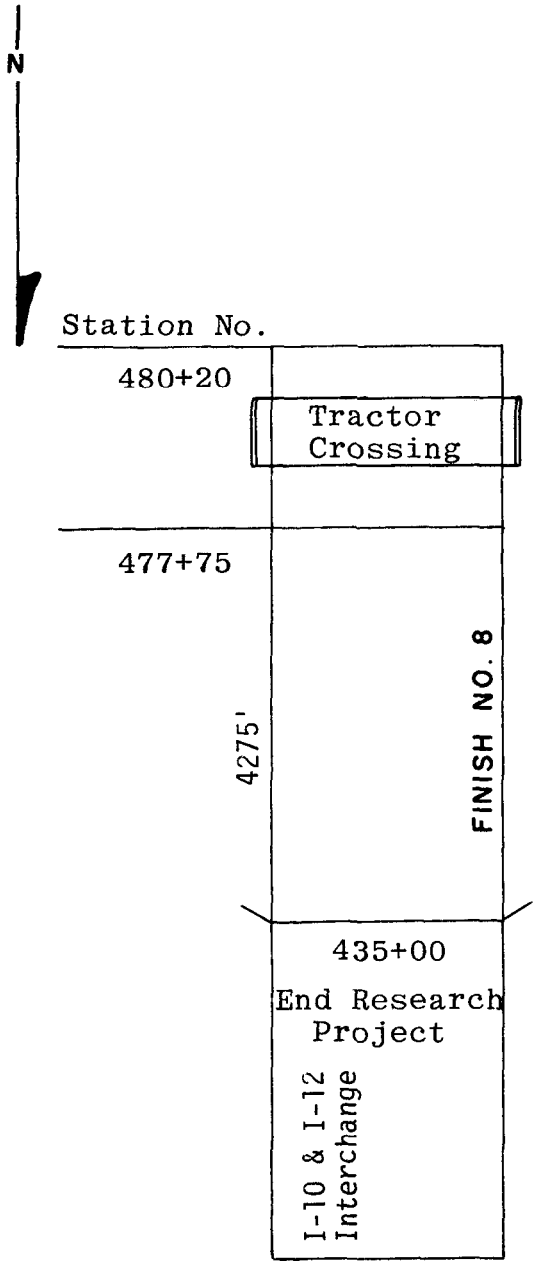
The roadway finish was subjected to testing immediately after construction was completed and then at 3, 6, 9, and 12 month intervals after the highway was opened to the public. The following procedures were used as a basis for testing the performance of each experimental section.



LOCATION OF TEST SECTIONS
FIGURE 1a



LOCATION OF TEST SECTIONS
FIGURE 1b



LOCATION OF TEST SECTIONS
FIGURE 1c

TABLE 1

STATIONING AND TYPES OF FINISHES

Texture No.	Station to Station		Type of Finish
1	658+00	640+00	Burlap Drag, Longitudinal (Control Section)
2	632+40	620+40	Mechanical Broom, Soft Bristle Brush, Transverse
3	620+40	600+75	Mechanical Broom, Heavy Polyplastic Transverse
3a	600+75	588+40	Mechanical Broom, Heavy Polyplastic Transverse - Retextured
4	588+40	561+20	Mechanical Broom, Extra Heavy Nylon, Transverse
4a	577+20	572+80	Mechanical Broom, Extra Heavy Transverse - Retextured
5	557+11	530+60	Metal Tines (1/2" center, 4" long), Transverse
6	525+74	507+70	Metal Tines (1/2" center, 4" long), Longitudinal, Preceded by Burlap Drag
7	507+70	480+20	Mechanical Broom, Extra Heavy Nylon, Longitudinal
8	477+75	435+00	Metal Tines (1/2" center, 4" long), Transverse, Preceded by Burlap Drag

I. Visual Observations included the use of photo-documentation. Future comparisons will be made using the original correlation as a reference. This procedure is not a test and is not definitive; therefore it is not intended to cast judgment upon a particular section. However, it does provide an accurate historical record of the construction and testing techniques, as well as an accurate log of aesthetic conditions at the time of inspection.

II. Skid testing provided the most useful data for performance evaluation. All skid resistance measurements were made using a skid testing trailer conforming to ASTM E-274-70, at controlled speeds and at designated time periods. During the first-year evaluation period, tests for skid resistance were made at speeds of 20 m.p.h., 40 m.p.h., 50 m.p.h., and 60 m.p.h.

At each quarterly test period the average skid reading with respect to the speed at which the reading was obtained was plotted onto a graph. The abscissa represented the the designated speeds of the test, and ordinate the skid number (coefficient of friction x 100). (A curve or line may then be drawn connecting the points.) The slope of this line is known as the speed gradient. Because of the vast amount of data collected, a computer was used in this study to determine the skid gradient.

III. The sand patch method was used to aid in the determination of texture depths. Refer to Appendix III for the complete procedure for performing this test. The sand patch method has been primarly used to determine the texture depths of pavements that were constructed using a single burlap drag, broomed, or a belted finish. Its use in determining the actual depth of a tined textured finish is questionable since there is intended space between each groove and most

grooves produced by a tine inherently have a lip of concrete mortar on each side. Also, should different personnel perform these tests, variability of results is almost always present. Therefore, the sand patch method is used in this study more as a guide or comparison between sections and should not be taken as actual depths of grooves.

When the depth of a groove produced by a tine is desired at a particular location, a tire tread depth wear gauge may be used. Refer to Appendix IV for the procedure for using this method. Concrete finishing techniques do not provide a perfectly uniform depth across or along a roadway. Several readings must be taken and averaged. This is a a very useful tool when constructing a finish, as it allows immediate adjustment in depth should the specification tolerances be exceeded.

IV. Noise level measurements were taken to determine the sonic characteristics produced by traffic riding on the textured sections. A test vehicle was driven over each of test sections at predetermined speeds. Noise levels were measured for both the exterior and interior of the vehicle. All measurements were made with a General Radio Type 1551-C Sound Level Meter operation on the A scale. The output of the meter was permanently recorded on a General Radio 1521-B Graphic Level Recorder.

Exterior Noise Levels

The sound level meter was set up 25 feet from the centerline of the lane of travel of the test vehicle. The meter was placed on a tripod approximately 3 1/2 feet above the pavement surface with the microphone perpendicular to the vehicle travel path. Care was taken to locate the

instrument vehicle and observers far enough from the sound level meter to minimize reflected sound waves.

Noise level measurements were conducted for test vehicle speeds of 40 m.p.h. and 60 m.p.h. A minimum of two test runs at each speed was conducted. Additional runs were made if it was judged that other noise sources interfered with the test or if the results of the two runs differed by one or more decibels.*

The vehicle was driven at a cruising speed (no acceleration or deceleration) with the motor engaged. Preliminary runs had indicated that there was little noise level difference between the motor-engaged and motor-disengaged conditions.

Interior Noise Levels

The sound level meter was setup at approximately driver's ear height between the driver and passenger sides of the front seat of the test vehicle. Sound level measurements were made continuously while travelling each test section. Vehicle speeds of 40 m.p.h. and 60 m.p.h. were used for the sound level measurements. The graphic level recording was analyzed by visually selecting an average maximum decibel reading over the length of the test section measurement.

V. Accident data was compiled from State Police records supplied to the Traffic and Planning Section of the Department. Copies of accident reports referenced to mileposts and tenths of miles are provided. The data is analyzed for accident trends.

* The sound level meter was recalibrated each time the meter was moved to a new test section.

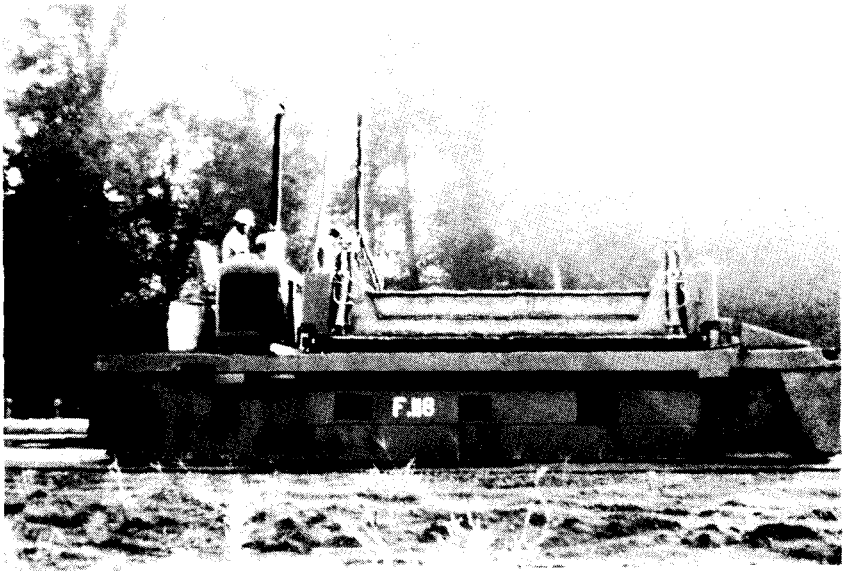


FIGURE 2
Rex Slip - Form Paver Used to Construct I-10 Highway near Baton Rouge, La.

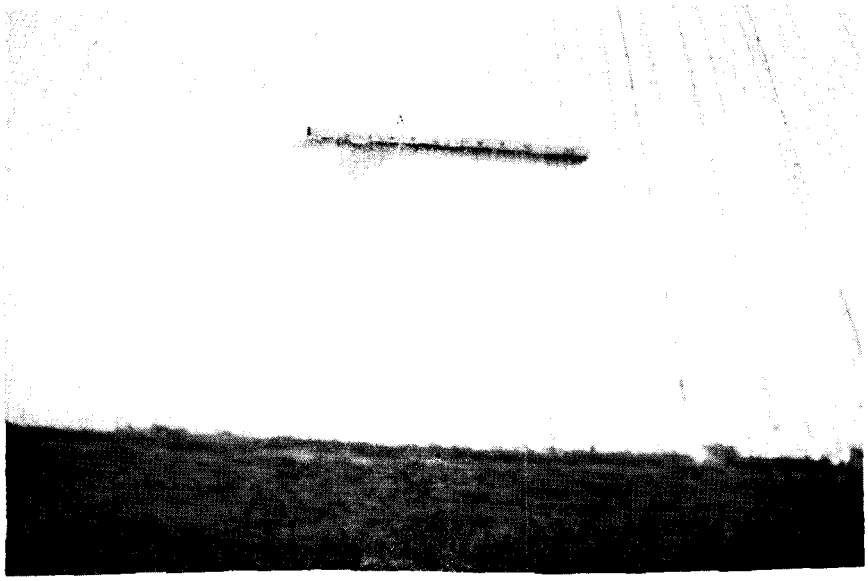


FIGURE 3
Mechanical Broom, Heavy Polyplastic,
Transverse Texture

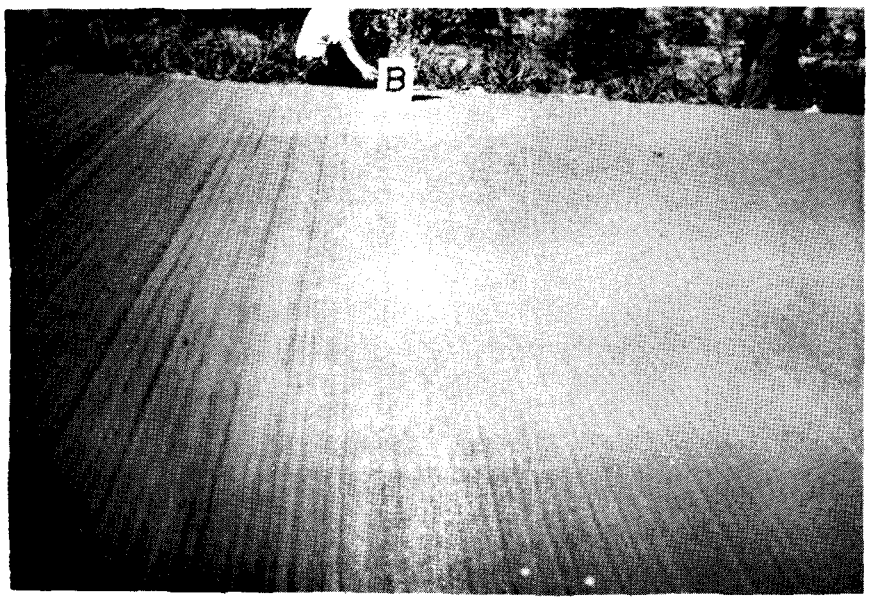


FIGURE 4
Mechanical Broom, Extra Heavy Nylon,
Transverse Texture

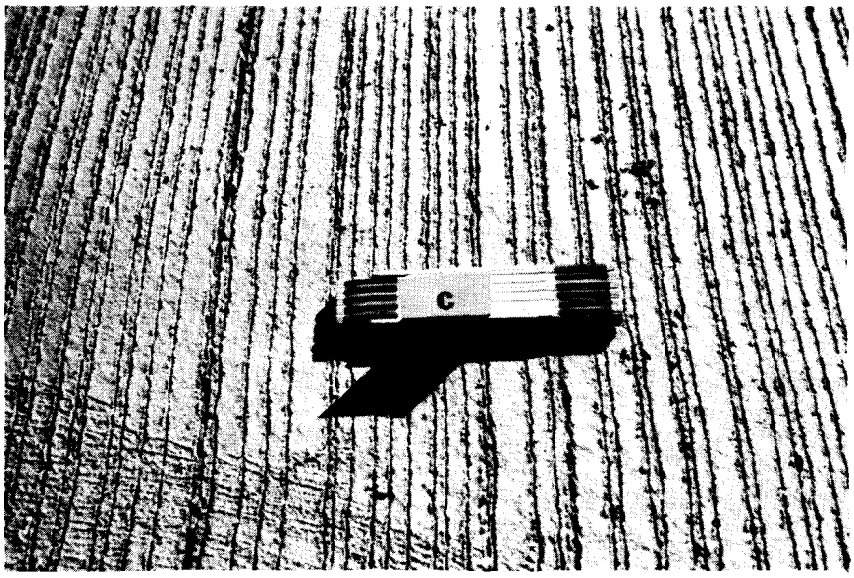


FIGURE 5
Mechanical (Metal) Tines,
Transverse Texture

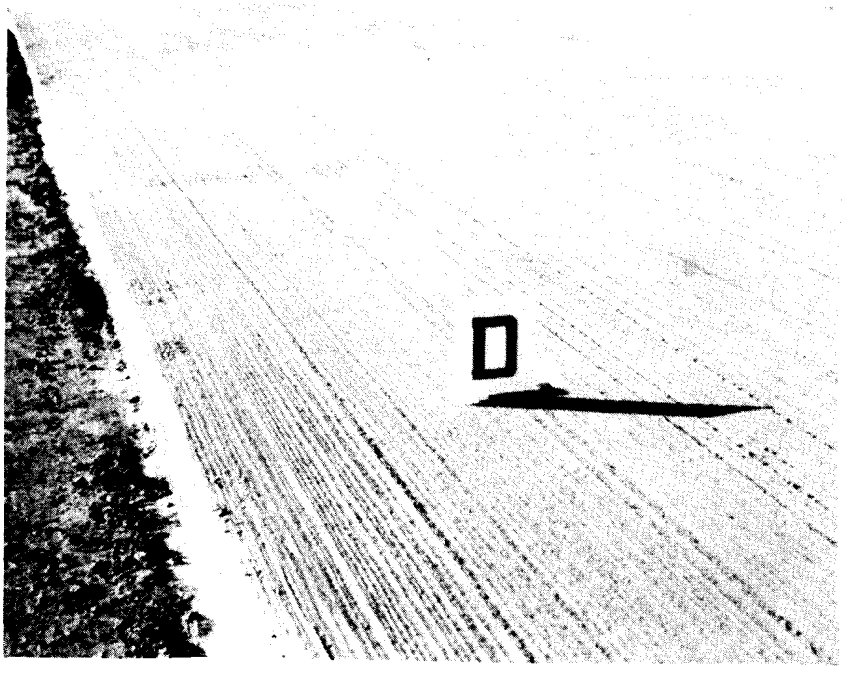


FIGURE 6
Mechanical (Metal) Tines, Longitudinal
Texture, Preceded by Burlap Drag

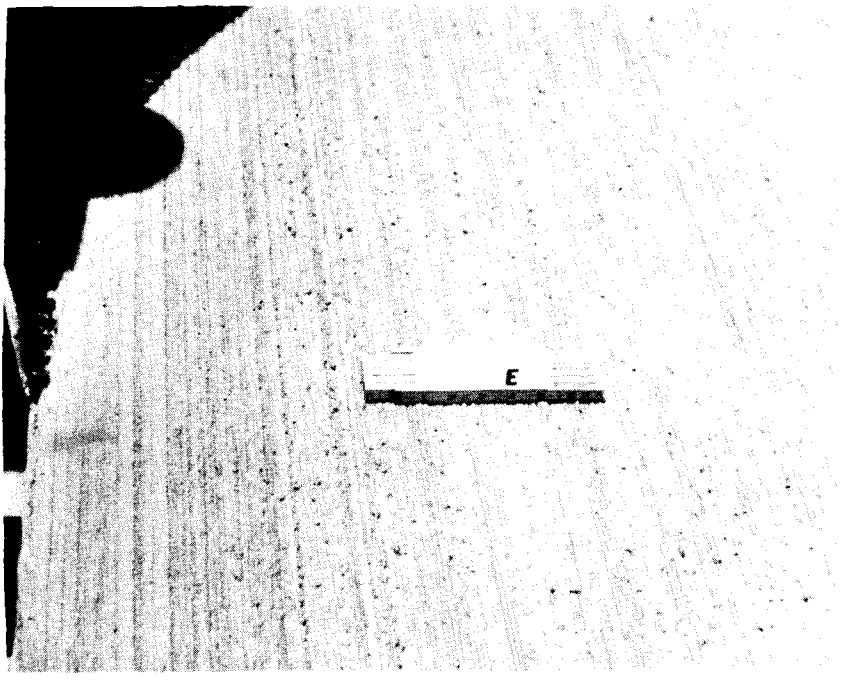


FIGURE 7
Mechanical Broom, Extra Heavy Nylon, Longitudinal Texture

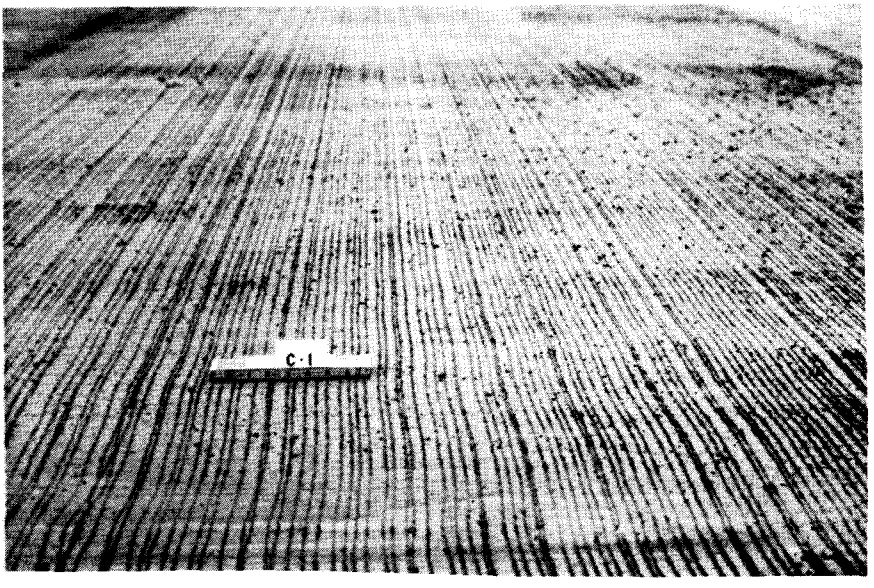


FIGURE 8
Mechanical (Metal) Tines, Transverse Texture, Preceded by Burlap Drag

GENERAL DISCUSSION

Types of Surface Texture

Eight different types of surface texture were constructed and are under evaluation. They are: normal burlap drag (control section), transverse texturing with soft bristle broom, transverse texturing with heavy polyplastic broom, transverse texturing with extra heavy nylon broom, transverse texturing with metal tines, longitudinal grooving with extra metal tines preceded by heavy burlap drag, longitudinal texturing with extra heavy nylon broom, and transverse grooving with metal tines preceded by heavy burlap drag. In addition, two areas within the experimental broom sections which were rained on had to be resurfaced with a neat cement grout and retextured. One area was retextured with a heavy polyplastic broom and the other with an extra heavy nylon broom. These two areas are being evaluated with the remainder of the test sections. Figures 3 through 8 show some of the various textures on as-built test sections. Texturing pictures are shown in the Appendix.

DESCRIPTION AND DISCUSSION OF SURFACE FINISHES

Finish No. 1

Burlap Drag Textured Finish

Two 24-ft. wide pieces of burlap cloth, each weighing 10 oz. per sq. yd., were hand sewed together so that one rested on top of the other. Each cloth was unraveled at one end approximately 6 inches, leaving trailing ends longitudinal to the pavement. The cloth was sufficiently long enough that when mounted onto the front of the texturing machine, 3 to 4 ft. of the burlap cloth would be in horizontal contact with the pavement to be textured (Figure 9 in the Appendix).

The burlap was dragged once immediately after the transverse contraction joints were placed. If the surface had excessive bleed water, or surface irregularities at the joint locations, the burlap drag was repeated until a gritty and uniform texture was obtained. Hardened grout was allowed to accumulate on the trailing or tag ends in hopes that a deeper texture could be obtained. Each morning the burlap was wetted and kept moist throughout the day. This was done to give the burlap cloth the extra weight needed to texture low slump concrete. At the end of each day's pour, the burlap mats were cleaned with water from a hose, or discarded and replaced with new burlap if cleaning was not possible. The average texture produced by this method did not exceed .024 inch as measured by the sand patch test. The researchers did not consider this depth of texture to be adequate.

Finish No. 2

Transverse Texturing with Soft Bristle Broom

This finish was produced by attaching the texturing broom (CMI No. 1-9180, Harper No. 7160) to the texturing machine and passing transversely once over the surface of the concrete. The broom was made of three lines 4-inch Palmyra fiber, spaced 11 rows per foot. Two 5-foot brooms were connected end to end to produce an overall length of 10 feet.

If the concrete to be finished is overly wet, any texturing with soft bristle broom will tend to flow back together after the broom has made its pass. And if the concrete surface is relatively dry, the broom will roll up small balls of dry concrete grout and leave them on the surface. From a short distance the small balls look like popped corn because of their porous nature. The researchers referred to this condition as "popcorning." The "popcorn" is not integral with the surface texture and quickly brushes off with a broom or light traffic.

Soon after the texturing operations began, the bristles of this broom got soft because of the moisture present in the concrete and produced a very smooth texture of 0.029 inch. It is anticipated that this texture will wear rapidly under heavy interstate traffic.

Finish No. 3

Transverse Texturing With Heavy Polyplastic Broom

This broom finish was produced by attaching the CMI heavy texturing broom (CMI No. 1-9181, Harper No. 9360) to the texturing machine and passing once over the surface transversely. The broom was made of two lines of 4-inch polypropylene black straight plastic fiber spaced 11 rows per foot (see Figure 10). Two 5-foot brooms were connected end to end to produce an overall length of 10 feet.

The initial average sand patch depth produced by this method of texturing was 0.039 inch. The time of finishing is critical, very often the grout was balled up to produce "popcorning" on the surface. The texture produced by this broom was better than that produced by soft bristle brooms. Figure 3 shows a typical transverse finish with heavy polyplastic broom.

Finish No. 3a

Retextured Transverse Finish With Heavy Polyplastic Broom

This particular section is located between Station 588+40 and Station 600+75, which is at the end of Finish No. 3. An unexpected heavy rain occurred, washing away most of the texture. After the rain stopped, a neat cement grout was placed onto the surface and retextured by the same method as its parent finish. It was decided by the researchers

that this section would be documented and listed separately in an effort to determine the longevity of this refinishing technique often used by contractors in this area.

The initial average sand patch depth was 0.028 inch. That depth is lower than the original average sand patch depth of 0.039 inch for the portions of the Heavy Polyplastic Broom Finish that were not rained upon and consequently did not require retexturing.

Finish No. 4

Transverse Texturing With Extra Heavy Nylon Broom

This broom finish was produced by attaching the CMI extra heavy nylon broom (CMI No. 1-9220) to the texturing machine and passing once over the surface of the concrete. The broom was made of two rows of very coarse, 1/8-inch diameter, nylon fibers in a cluster approximately 3/4 inch in diameter (see Figure 11). Two 5-foot brooms were connected end to end to produce a 10-foot broom for transverse texturing. The broom was capable of producing a very rough and uniform texture.

The initial average sand patch depth was 0.056 inch. With this broom, like all other brooms that were tried, the time of finishing was so critical that a few minutes would make a great difference on the final finished product. Generally, the surface had to be textured prior to the disappearance of water sheen from the surface of the pavement, otherwise balling of the grout or "popcorning" (see Figure 12) would occur and the result would be a poor surface texture with a low texture depth. This broom produced a texture superior to those produced by the soft bristle and heavy polyplastic brooms.

Finish No. 4a

Retextured Transverse Finish With Extra Heavy Nylon Broom

This section is located between Stations 577+20 and 572+80, which is in the middle of Finish No. 4. Again a rain occurred after the daily pour began and washed away most of the texture. A neat cement grout was placed onto the damaged surface after the rain stopped, and finished in the same method as Finish No. 4.

The initial average sand patch depth was 0.078 inch, which is a deeper texture than the extra heavy nylon broom finished sections that were not rained on and did not require retexturing.

Finish No. 5

Transverse Texturing With Metal Tines

This finish was produced by attaching the CMI's metal tines (CMI No. 1-9203) to the texturing machine and passing once or twice over the surface of the concrete. The combs were made of a single row of flat wire teeth, inserted into holes in a 2-inch by 2-inch wooden head and 1-inch square wood baffel strips secured on each side of the teeth. The metal tines were 0.032 inch by 0.083 inch steel flat wire on 1/2-inch centers, 4 inches long, with a 5-foot overall length of comb. Two 5-foot combs were connected end to end to produce a 10-foot comb for transverse texturing.

The initial average sand patch depth was 0.033 inch for transverse texturing with metal tines. It was quickly learned that the time of finishing for this method is very critical. Should the metal tines be applied to the surface too early, the aggregate would be dragged up leaving a very undesirable finish, and if applied too late, the surface would not be textured sufficiently for good skid results. Only with experience can one determine when to apply the tines. Figure 5 shows a typical transverse finish with metal tines.

Finish No. 6

Longitudinal Texturing With Metal Tines Preceded by Burlap Drag

The finish was produced by attaching the CMI metal tines (CMI No. 1-9203) to the texturing machine and passing once over the surface of the concrete preceded by a burlap drag. The overall length of the tining comb was 24 feet.

The initial sand patch depth was 0.034 inch. Figure 6 shows a typical finish. The burlap drag, which was connected to the front of the finishing machine, was used to rid the surface of excess moisture

in advance of tining. With the surface free of excess water the curing compound was applied at the same time as grooving of concrete. This system worked well, as no delays were encountered and the operation was able to keep up with the paving train.

Finish No. 7

Longitudinal Texturing With Extra Heavy Nylon Broom

This broomed finish was produced by attaching the CMI extra heavy nylon broom (CMI No. 1-9220) to the texturing machine and passing once over the surface of the concrete. The overall length of the broom was 24 feet. This broom was capable of producing a very rough and uniform texture.

The initial average sand path depth was 0.052 inch. The time of finish was critical and the surface had to be textured prior to the disappearance of water sheen from the surface; otherwise "popcorning" would have occurred, and the surface would have had a low texture depth and poor surface texture. This broom, which was also used for Finish No. 4, produced a texture superior to the soft bristle and heavy polyplastic brooms. Figure 7 shows a typical longitudinal finish with the extra heavy nylon broom.

Finish No. 8

Transverse Texturing With Metal Tines Preceded by Burlap Drag

This finish was produced by attaching the CMI metal tines (CMI No. 1-9203) to the texturing machine and passing once over the surface of the concrete preceded by a burlap drag. Two 5-foot combs were connected end to end to produce a 10-foot comb.

The initial average sand patch depth was 0.039 inch. Figure 8 shows a typical finish. The burlap drag (which is draped from the front of the finishing machine) was again used to rid the surface of excess moisture. The texturing machine used in this study had the capability of being used as a curing machine. However, since transverse tining is performed when the machine is stationary, the curing operation had

to be performed as a separate function. After a section of the highway had been tined, the machine would back up to the previously completed section and then proceed forward spraying curing compound to the point at which the tining had stopped, then begin tining again, back up and spray compound, then tine, and so on. This at best was a difficult situation requiring too much coordination between the texturing operation and the curing operation. It is highly recommended that a separate curing machine be used when texturing is accomplished by transverse tining.

Discussion of Skid Resistance Measurements

The initial data obtained from the various textured finishes are listed in Table 2. This table contains information relating to the skid numbers at 20 mph, 40 mph, and 60 mph; the speed gradients; the average sand patch texture depths; and the exterior noise levels at 40 mph and 60 mph.

Table 3 gives the average skid resistance test data for the first year evaluations.

Generally the skid numbers for all experimental textures were higher than the burlap drag texture which was specified standard in the Louisiana Department of Highways Specifications. The exception was the retextured portion, using the heavy polyplastic broom with the transverse texture, located between Station 588+40 and Station 600+75. Initial skid numbers on all experimental textures ranged from 56 to 74 at 20 mph, 43 to 71 at 40 mph, and 38 to 54 at 60 mph.

The extra heavy nylon broom, along with the metal tines, produced a texture with a high initial skid number. Metal tines (0.032 by 0.083 inch steel flat wire, 3 to 4 inches long, spaced on 1/2-inch centers), preceded by heavy burlap drag and applied transversely to the center-line of the concrete pavement, produced grooves 1/8 to 3/16 inch deep with the highest average skid number at 60 mph and the lowest speed gradient.

Discussion of Noise Levels

The noise levels of the tined textures were not appreciably higher than those of the normal burlap dragged section (control). However, the noise levels for the broom finished sections were higher than for both the burlap dragged and tined sections. Refer to Table 2 for the noise data.

Discussion of Accident Data

At this time, since the accident data is very meager and inconclusive, a discussion will not be attempted. When sufficient accident data is available and conclusions can be made, then a discussion of this data will be incorporated in the report.

TABLE 2

INITIAL EVALUATION DATA

TEXTURING OF CONCRETE PAVEMENTS-RESEARCH PROJECT NO. 72-3C

*Type of Finish	SN_{20}	SN_{40}	SN_{60}	Speed Gradient	Avg. Sand Patch Texture Depth. In.	Exterior Noise Levels 40 mph	60 mph
1	60	45	38	0.50	0.024	74dBA	79dBA
2	65	50	45	0.50	0.029	76dBA	82dBA
3	70	66	52	0.50	0.039	76dBA	83dBA
4	73	66	50	0.55	0.056	75dBA	83dBA
4a	73	71	47	0.63	0.078	79dBA	86dBA
5	70	61	53	0.43	0.033	73dBA	80dBA
6	74	58	47	0.70	0.034	72dBA	79dBA
7	67	58	49	0.45	0.052	75dBA	81dBA
8	69	67	54	0.40	0.039	74dBA	80dBA

*Type of Finish

1 Normal Burlap Drag Texturing (Reference)

2 Transverse Texturing with Soft Bristle Broom

3 Transverse Texturing With Heavy Polyplastic Broom

4 Transverse Texturing with Extra Heavy Nylon Broom

4a Transverse Texturing with Extra Heavy Nylon Broom - Neat Cement Grout added and Re-Textured

5 Transverse Grooving with Metal Tines (1/2 inch spacing)

6 Longitudinal Grooving with Metal Tines (1/2 inch spacing), preceded by burlap drag)

7 Longitudinal Texturing with Extra Heavy Nylon Broom

8 Transverse Grooving with Metal Tines (1/2 inch spacing, preceded by burlap drag)

NOTE: All sections constructed June 1973 and opened to traffic June 1974.

TABLE 3

AVERAGE SKID MEASUREMENTS

Texture Number	20 m.p.h. I-3-6-9-12	40 m.p.h. I-3-6-9-12	50 m.p.h. I-3-6-9-12	60 m.p.h. I-3-6-9-12
1	60-58-NA-60-62	45-46-48-48-55	NA-42-43-47-54	38-38-39-39-52
2	65-66-NA-65-69	50-53-58-54-58	NA-48-50-52-57	45-45-49-45-56
3	70-70-NA-68-68	66-58-60-58-60	NA-52-50-51-58	52-48-46-46-52
3a	56-72-NA-51-65	43-53-50-43-37	NA-43-40-30-39	42-42-38-32-39
4	73-72-NA-65-68	66-59-59-55-57	NA-55-52-52-57	50-50-47-45-53
4a	73-75-NA-70-69	71-64-60-57-57	NA-53-54-53-60	47-50-43-48-55
5	70-67-NA-66-72	61-56-56-55-57	NA-53-51-50-53	53-52-49-46-53
6	74-64-NA-64-71	58-50-55-52-56	NA-47-49-46-56	47-45-42-43-52
7	67-70-NA-69-70	58-55-58-57-60	NA-52-50-51-57	49-46-43-45-54
8	69-68-NA-67-71	67-59-59-56-59	NA-56-54-53-58	54-54-50-49-54

CODING:

I = Initial
NA = Not Available
3 = 3 Months
6 = 6 Months
9 = 9 Months
12 = 12 Months
Re = Retexture

TABLE 4

AGGREGATE DATA

T. J. James Stockpile 6/22/73

Fine Aggregate

Screen	Wt. Retained Pounds	Percent Retained	Accum. % Coarser	Accum. % Passing
3/8"	0	0	0	100
#4	11.1	2.1	2.1	97.0
#16	99.3	18.9	21.0	79.0
#30	102.4	19.5	40.5	____
#40	119.6	22.7	63.2	____
#50	106.7	20.3	83.5	16.5
#100	79.6	15.1	98.5	1.4
Pass #100	7.6	1.4		
Totals	526.3	100		
Wt. Before Sieving	526.3			

Specific Gravity = 2.62

Coarse Aggregate

2 1/2"				
2"				
1 1/2"	0	0	0	100
1"	1.26	4.3	4.3	95.7
3/4"	3.89	13.2	17.5	82.5
1/2"	12.19	41.4	58.9	41.1
#4	11.71	39.7	98.6	1.4
Pass #4	0.41	1.4		
Totals	29.46	100		
Wt. Before Sieving	29.46			

Specific Gravity = 2.53

TABLE 5

CONCRETE MIX DATA

Cement	Portland Cement Type I (5.8 bags/cubic yard)
Entrained Air	4% by volume
Slump	1/2 inch to 2 inches
Water, max. allowable	5.5 gal/bag of cement

OBSERVATIONS AND RECOMMENDATION

Observations

The following observations were noted:

1. Generally skid numbers for all experimental textures were higher than the burlap drag texture which was specified standard in the Louisiana Department of Highways Specifications and extensively used throughout the State.

2. Metal tines, preceded by heavy burlag drag and applied transversely to the centerline of the concrete pavement, produced grooves 1/8 to 3/16 inch deep with the highest skid number, the lowest speed gradient and with noise levels comparable to those of the normal burlap drag. This texturing technique has been adopted by the Louisiana Department of Highways as standard on all concrete pavements and bridge decks.

3. The extra heavy nylon broom is capable of producing a texture with high initial skid number, but the time of finishing was so critical that a uniform texture could not consistently be obtained. (It is anticipated that the broom finish will wear more rapidly than the tine finish).

4. None of the experimental textures produced objectionable road noise or increased the noise level significantly.

5. Accident data at this time is very meager and is inconclusive.

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APPENDIX

FIGURE 9
Normal Burlap Drag
In Back of Float

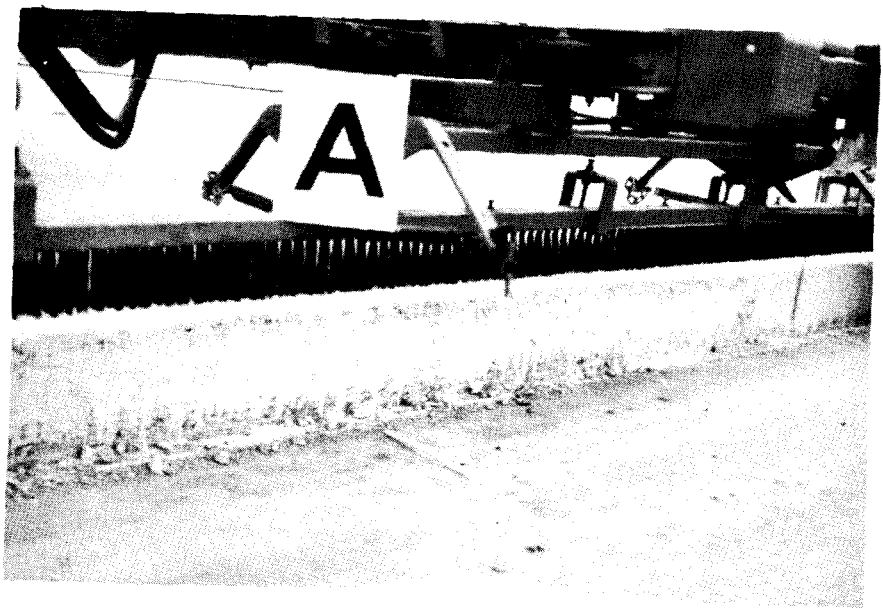

FIGURE 10
Heavy Polyplastic Broom on
Transverse Texturing

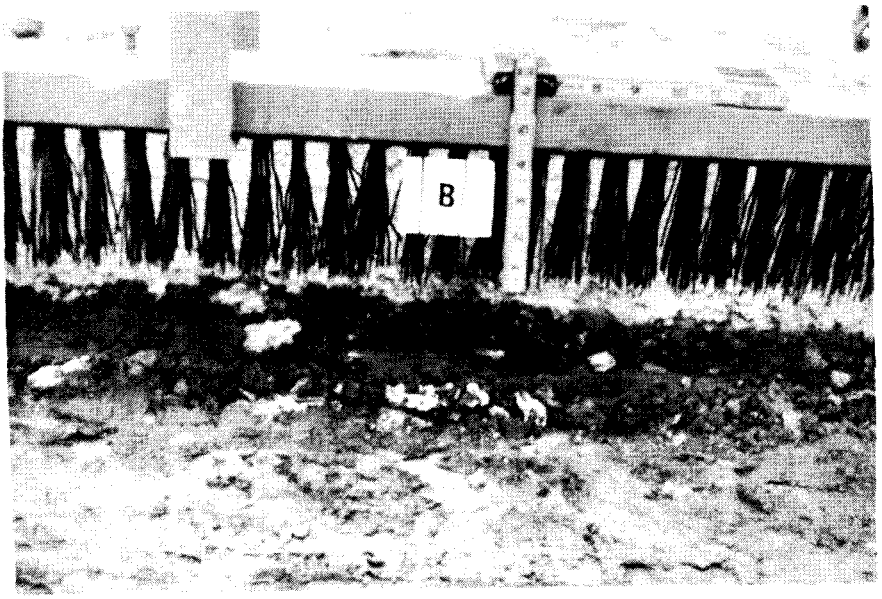

FIGURE 11
Extra Heavy Nylon Broom on
Transverse Texturing

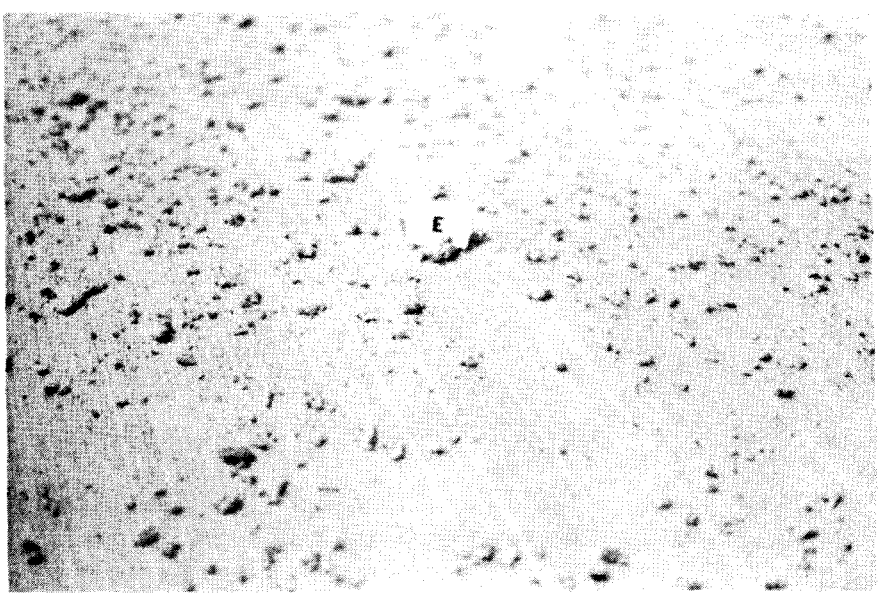

FIGURE 12
"Popcorning" on Longitudinal Texturing
with Extra Heavy Nylon Broom

NORMAL BURLAP DRAG TEXTURING (REFERENCE)
(FINISH #1)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			INITIAL EVALUATION			
54	53	42		38		0.028
55	55	46				0.020
56	55	44		34		0.022
*57	68	50		42		0.025
58	58	44		34		0.024
59	60	42		36		0.024
*60	70	48		42		0.027
AVG.	60	45		38	0.55	0.024
			3 MONTH EVALUATION			
54	53	46	42	38		0.022
55	53	47				0.020
56	53	45	40	39		0.017
*57	56	46	43	41		0.023
58	58	45	40	37		0.018
59	70	46	40	37		0.017
*60	61	46	46	39		0.019
AVG.	58	46	42	38	0.50	0.019

* LEFT LANE

NORMAL BURLAP DRAG TEXTURING (REFERENCE)
(FINISH #1)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			6 MONTH EVALUATION			
54		51	42	38		0.020
55		48				0.016
56		50	41	39		0.016
*57		45	45	39		0.023
58		50	43	39		0.017
59		48	48	40		0.016
*60		44	43	41		0.020
AVG.		48	43	39	0.40	0.018
			9 MONTH EVALUATION			
54	58	48	42	38		0.019
55						0.016
56	60	51	41	39		0.016
*57		50	63	43		0.022
58	64	48	41	34		0.018
59	60	46	45	38		0.016
*60	60	48	48	44		0.019
AVG.	60	48	47	39	0.50	0.018

* LEFT LANE

NORMAL BURLAP DRAG TEXTURING (REFERENCE)
(FINISH #1)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			ONE YEAR EVALUATION			
54	61	58	55	51		0.020
55	65					0.017
56	63	55	55	56		0.018
*57	61	55	54	51		0.024
58	55	54	53	51		0.019
59	61	56	52	48		0.018
*60	65	52	55	53		0.020
AVG.	62	55	54	52	0.26	0.019

* LEFT LANE

TRANSVERSE TEXTURING WITH SOFT BRISTLE BROOM (FINISH #2)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			INITIAL EVALUATION			
1	73	55		46		0.033
2	56	41		39		0.026
*3		48				0.032
4	66	56		51		0.024
AVG.	65	50		45	0.50	0.029
			3 MONTH EVALUATION			
1	63	58	47	41		0.019
2	64	51	47	41		0.019
*3	68	51	50	45		0.021
4	70	52	48	54		0.018
AVG.	66	53	48	45	0.54	0.019
			6 MONTH EVALUATION			
1		56	53	58		0.016
2		55	46	41		0.018
*3		48	48	43		0.021
4		59	53	56		0.016
AVG.		55	50	49	0.31	0.018

* LEFT LANE

TRANSVERSE TEXTURING WITH SOFT BRISTLE BROOM
(FINISH #2)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			9 MONTH EVALUATION			
1	67	53	53	44		0.016
2	65	53	42	42		0.017
*3	63	54	58	41		0.019
4	64	55	54	54		0.017
AVG.	65	54	52	45	0.52	0.017
			ONE YEAR EVALUATION			
1	69	55	60	51		0.017
2	68	60	55	52		0.019
*3	72	55	56	58		0.022
4	69	63	55	64		0.018
AVG.	69	58	57	56	0.35	0.019

* LEFT LANE

TRANSVERSE TEXTURING WITH HEAVY POLYPLASTIC BROOM
(FINISH #3)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			INITIAL EVALUATION			
5	73	67		51		0.043
6	69	60		51		0.023
*7	74	67		57		0.043
8	74	66		52		0.037
*9	70	69				0.043
10	67	66		49		0.033
11	62					0.050
AVG.	70	66		52	0.50	0.039
			3 MONTH EVALUATION			
5	70	58	48	48		0.019
6	68	56	47	45		0.019
*7	76	56	54	50		0.021
8	67	58	48	43		0.023
*9	76	63	60	51		0.024
10	65	58	54	48		0.024
11						0.027
AVG.	70	58	52	48	0.54	0.022

* LEFT LANE

TRANSVERSE TEXTURING WITH HEAVY POLYPLASTIC BROOM
(FINISH #3)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			0 MONTH EVALUATION			
5		60	52	48		0.017
6		59	51	48		0.017
*7		58	48	44		0.021
8		58	50	44		0.021
*9						0.024
10		63	51	46		0.019
11		60	50	46		0.022
AVG.		60	50	46	0.69	0.020
			9 MONTH EVALUATION			
5	69	55	54	46		0.018
6	64	63	52	50		0.016
*7	68	60	54	48		0.021
8	65	51	46	42		0.021
*9	72	61	55			0.021
10	70	58	46	42		0.022
11	50	60	25	26		0.025
AVG.	65	58	47	42	0.59	0.021

* LEFT LANE

TRANSVERSE TEXTURING WITH HEAVY POLYPLASTIC BROOM
(FINISH #3)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			ONE YEAR EVALUATION			
5	68	55	59	52		0.018
6	68	55	52	54		0.018
*7	70	60	58	59		0.021
8	72	60	58	56		0.019
*9	74	65	61	58		0.022
10	67	61	59	55		0.021
11	55	30	32	30		0.022
AVG.	68	56	54	52	0.38	0.020

* LEFT LANE

RETEXTURED TRANSVERSE FINISH WITH HEAVY POLYPLASTIC BROOM
(FINISH #3A)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			INITIAL EVALUATION			
12	47	41				0.024
13	61	49		39		0.028
14	56	42		43		0.025
15	59	44		43		0.035
AVG.	56	44		42		0.028
			3 MONTH EVALUATION			
12						0.021
13	69	55	46			0.024
14	78	61		43		0.023
15	69	44	40	41		0.025
AVG.	72	53	43	42		0.023
			6 MONTH EVALUATION			
12		43	32	29		0.018
*13		63	52	42		0.024
14		40	31	42		0.020
*15		52	44	33		0.019
AVG.		50	40	38		0.020

* LEFT LANE

RETEXTURED TRANSVERSE FINISH WITH HEAVY POLYPLASTIC BROOM
(FINISH #3A)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			9 MONTH EVALUATION			
12	45	30	28	26		0.020
*13	58	44	48	38		0.022
14	50	34	26	39		0.021
*15						0.028
AVG.	51	38	34	34	0.58	0.023
			ONE YEAR EVALUATION			
12	48	40	39	32		0.018
13	73	43	45	38		0.024
14	70	32	39	46		0.020
15	70	42	42	51		0.028
AVG.	65	39	41	42	0.55	0.023

* LEFT LANE

TRANSVERSE TEXTURING WITH EXTRA HEAVY NYLON BROOM
(FINISH #4)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			INITIAL EVALUATION			
16	68	66		53		0.062
*17	73	69		61		0.069
18	81	58		41		0.033
*19	74	65		50		0.046
22	74	74		52		0.066
23	69	62		43		0.063
*24	74	68		48		0.055
AVG.	73	66		50	0.59	0.056
			3 MONTH EVALUATION			
16	70	55	55	56		0.041
*17	73	65	63	59		0.037
18	72	63	48	40		0.025
*19	70	56	53	44		0.030
22	73	59	61	58		0.040
23	68	55	54	44		0.043
*24	80	59	53	51		0.032
AVG.	72	59	55	50	0.50	0.035

* LEFT LANE

TRANSVERSE TEXTURING WITH EXTRA HEAVY NYLON BROOM
(FINISH #4)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			6 MONTH EVALUATION			
16		61	55	55		0.036
*17		65	56	48		0.041
18		56	51	38		0.023
*19		53	46	37		0.032
22		60	59	54		0.036
23		59	48	54		0.041
*24		59	50	43		0.034
AVG.		59	52	47	0.61	0.035
			9 MONTH EVALUATION			
16	45	30	53	48		0.035
*17	70	60	60	59		0.038
18	64	60	42	39		0.022
*19	68	55	51	42		0.028
22	73	58	51	43		0.038
23	69	60	53	41		0.033
*24	69	60	53	45		0.034
AVG.	65	55	52	45	0.50	0.033

* LEFT LANE

TRANSVERSE TEXTURING WITH EXTRA HEAVY NYLON BROOM
(FINISH #4)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			ONE YEAR EVALUATION			
16	72	61	60	55		0.028
*17	61	60	65	59		0.038
18	77	53	48	46		0.022
*19	52	53	60	48		0.029
22	74	60	56	55		0.036
23	70	58	52	54		0.033
*24	74	56	60	56		0.035
AVG.	69	57	57	53	0.35	0.032

---

* LEFT LANE

RETEXTURED TRANSVERSE FINISH WITH EXTRA HEAVY NYLON BROOM
(FINISH #4A)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			INITIAL EVALUATION			
20	71	69		46		0.076
*21	75	73		48		0.080
AVG.	73	71		47	0.63	0.078
			3 MONTH EVALUATION			
20	78	67	54	52		0.052
*21	72	60	52	47		0.046
AVG.	75	64	53	50	0.62	0.049
			6 MONTH EVALUATION			
20		60	55	44		0.051
*21		59	53	42		0.056
AVG.		60	54	43	0.86	0.054
			9 MONTH EVALUATION			
20	68	55	51	44		0.050
*21	73	59	55	53		0.051
AVG.	70	57	53	48	0.55	0.051
			ONE YEAR EVALUATION			
20	72	55	58	55		0.046
*21	67	59	61	55		0.045
AVG.	70	57	60	55	0.35	0.046

* LEFT LANE

TRANSVERSE GROOVING WITH METAL TINES (1/2 INCH SPACING)
(FINISH #5)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			INITIAL EVALUATION			
25	74	67		58		0.027
26	66	61		54		0.041
*27	69	64		61		0.054
28	68	61		46		0.016
29	75	57		44		0.026
30	68	55		54		0.034
AVG.	70	61		53	0.43	0.033
			3 MONTH EVALUATION			
25	69	55	55	56		0.022
26	65		51	52		0.029
*27	68	65	63	59		0.041
28	68	53	44	41		0.016
29	67	56	48	50		0.024
30	58	51	57	51		0.032
AVG.	66	56	53	52	0.32	0.027

* LEFT LANE

TRANSVERSE GROOVING WITH METAL TINES (1/2 INCH SPACING)
(FINISH #5)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			6 MONTH EVALUATION			
25		59	55	60		0.022
26		60	51	51		0.026
*27		61	56	48		0.048
28		52	45	38		0.014
29		53	45	40		0.023
30		54	52	50		0.027
AVG.		56	51	49	0.34	0.027
			9 MONTH EVALUATION			
25	67	54	48	55		0.020
26	63	55	51	44		0.030
*27	73	63	59	52		0.044
28	65	60	43	42		0.014
29	64	53	46	40		0.023
30	65	47	55	44		0.029
AVG.	66	55	50	46	0.50	0.027

* LEFT LANE

TRANSVERSE GROOVING WITH METAL TINES (1/2 INCH SPACING)
(FINISH #5)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			ONE YEAR EVALUATION			
25	73	58	37	60		0.019
26	72	60	58	54		0.029
*27	77	59	60	53		0.045
28	73	55	54	46		0.035
29	70	54	54	53		0.024
30	68	58	53	51		0.030
AVG.	72	57	53	53	0.50	0.029

* LEFT LANE

LONGITUDINAL GROOVING WITH METAL TINES (1/2 INCH SPACING)
PRECEDED BY BURLAP DRAG
(FINISH #6)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			INITIAL EVALUATION			
31	68	61		53		0.031
32	66	63		43		0.065
*33	76	61		49		0.027
34	74	60		52		0.020
35	79	51		41		0.022
*36	81	52		41		0.036
AVG.	74	58		47	0.70	0.034
			3 MONTH EVALUATION			
31	58	51	43	48		0.023
32	67	52	46	43		0.042
*33	65	50	50	47		0.019
34	58	47	53	48		0.015
35	73	52	43	44		0.017
*36	65	50	45	40		0.026
AVG.	64	50	47	45	0.47	0.024

* LEFT LANE

LONGITUDINAL GROOVING WITH METAL TINES (1/2 INCH SPACING)
PRECEDED BY BURLAP DRAG
(FINISH #6)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			0 MONTH EVALUATION			
31		58	52	48		0.023
32		58	53	44		0.042
*33		55	53	46		0.020
34		60	51	42		0.018
35		51	43	36		0.019
*36		46	42	35		0.029
AVG.		55	49	42	0.66	0.025
			9 MONTH EVALUATION			
31	63	55	45	42		0.019
32	63	50	47	38		0.039
*33	68	53	47	44		0.019
34	65	55	47	46		0.018
35	60	55	45	40		0.019
*36	64	47	44	47		0.027
AVG.	64	52	46	43	0.55	0.024

* LEFT LANE

LONGITUDINAL GROOVING WITH METAL TINES (1/2 INCH SPACING)
PRECEDED BY BURLAP DRAG
(FINISH #6)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			ONE YEAR EVALUATION			
31	69	55	54	58		0.022
32	65	54	55	52		0.041
*33	74	59	59	48		0.019
34	73	60	60	55		0.017
35	72	53	53	50		0.019
*36	73	53	55	48		0.028
AVG.	71	56	56	52	0.47	0.024

* LEFT LANE

LONGITUDINAL TEXTURING WITH EXTRA HEAVY NYLON BROOM
(FINISH #7)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			INITIAL EVALUATION			
37	69	59		47		0.043
38	69	58		49		0.046
*39	74	56		51		0.044
40	69	54		45		0.066
41	73	61		60		0.063
*42	42	61		47		0.035
43	71	58		43		0.067
AVG.	67	58		49	0.45	0.052
			3 MONTH EVALUATION			
37	72	56	53	45		0.028
38	70	53	47	47		0.032
*39	70	55	54	48		0.024
40	76	58	54	43		0.052
41	68	54		52		0.042
*42	67	53	53	42		0.023
43	67	58	54			0.039
AVG.	70	55	52	46	0.63	0.034

* LEFT LANE

LONGITUDINAL TEXTURING WITH EXTRA HEAVY NYLON BROOM
(FINISH #7)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			6 MONTH EVALUATION			
37		61	48	38		0.031
38		59	52	45		0.032
*39		56	52	48		0.027
40		60	51	39		0.049
41		55	56	53		0.039
*42		55	51	44		0.023
43		59	42	38		0.039
AVG.		58	50	44	0.75	0.034
			9 MONTH EVALUATION			
37	64	48	48	40		0.026
38	68	59	52	47		0.030
*39	69	60	60	51		0.028
40	73	58	48	46		0.050
41	68	55	53	48		0.031
*42	72	60	53	48		0.022
43	67	58	44	35		0.036
AVG.	69	57	51	45	0.60	0.032

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* LEFT LANE

LONGITUDINAL TEXTURING WITH EXTRA HEAVY NYLON BROOM
(FINISH #7)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			ONE YEAR EVALUATION			
37	70	64	51	51		0.029
38	72	63	60	53		0.033
*39	76	65	60	54		0.027
40	74	53	55	56		0.053
41	68	58	63	61		0.033
*42	69	63	61	58		0.023
43	64	51	48	48		0.043
AVG.	70	60	57	54	0.41	0.034

* LEFT LANE

TRANSVERSE GROOVING WITH METAL TINES (1/2 INCH SPACING)
PRECEDED BY BURLAP DRAG
(FINISH #8)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			INITIAL EVALUATION			
44	74	66		51		0.029
45	66	72		53		0.040
46	69	71		56		0.027
*47	66	70		60		0.027
48		66		51		0.053
49		62		51		0.040
*50	67	66		46		0.041
51	70	66		64		0.062
52		63				0.035
53		68				0.035
AVG.	69	67		54	0.40	0.039

* LEFT LANE

TRANSVERSE GROOVING WITH METAL TINES (1/2 INCH SPACING)
PRECEDED BY BURLAP DRAG
(FINISH #8)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			3 MONTH EVALUATION			
44	69	64	55	58		0.025
45	68	59	58	58		0.041
46	73	60	54	58		0.027
*47	69	61	60	60		0.030
48	68	56	52	55		0.048
49	65	58	54	48		0.038
*50	72	63	65	54		0.041
51	67	60	53	48		0.048
52	64	52	51	47		0.030
53						0.028
AVG.	68	59	56	54	0.36	0.036

* LEFT LANE

TRANSVERSE GROOVING WITH METAL TINES (1/2 INCH SPACING)
PRECEDED BY BURLAP DRAG
(FINISH #8)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			6 MONTH EVALUATION			
44		56	56	53		0.022
45		59	51	52		0.037
46		58	55	53		0.026
*47		64	58	53		0.027
48		59	55	51		0.043
49		59	55	51		0.032
*50		58	54	54		0.037
51		59	54	44		0.043
52		54	47	43		0.026
53		60	51	48		0.026
AVG.		59	54	50	0.45	0.032

* LEFT LANE

TRANSVERSE GROOVING WITH METAL TINES (1/2 INCH SPACING)
PRECEDED BY BURLAP DRAG
(FINISH #8)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			9 MONTH EVALUATION			
44	64	46	53	51		0.019
45	65	61	53	48		0.038
46	67	59	54	46		0.021
*47	69	58	55	52		0.027
48	72	58	55	47		0.040
49	67	56	52	44		0.031
*50	68	55	59	53		0.037
51	68	56	55	53		0.039
52	67	55	45	51		0.025
53	67	52	47	44		0.025
AVG.	67	56	53	49	0.45	0.030

* LEFT LANE

TRANSVERSE GROOVING WITH METAL TINES (1/2 INCH SPACING)
PRECEDED BY BURLAP DRAG
(FINISH #8)
(CONTINUED)

AREA NO.	SN@20	SN@40	SN@50	SN@60	SPEED GRADIENT	AVERAGE TEXTURE DEPTH, IN
			ONE YEAR EVALUATION			
44	68	58	60	59		0.022
45	68	60	55	55		0.038
46	72	61	60	55		0.028
*47	73	63	64	56		0.027
48	70	54	56	56		0.040
49	73	58	56	53		0.051
*50	78	64	60	54		0.036
51	68	55	55	53		0.043
52	68	58	55	48		0.026
53	68	58	54	54		0.026
AVG.	71	59	58	54	0.43	0.032

* LEFT LANE

Method of Test for

MEASURING TEXTURE DEPTH OF PORTLAND CEMENT CONCRETE WITH METAL TINE FINISH

LDH Designation: TR 229-73

Scope

1. This method describes the procedure for measuring texture depth of fresh or hardened concrete finished with a metal tine.

Apparatus

2. (a) A tire tread depth measuring gauge with 1/32 of an inch (1 mm) graduations similar to the one shown in Figure 1.

(b) Wire brush

(c) Steel straightedge approximately 1/4 x 1 x 12 inches (6 x 25 x 305 mm).

Procedure

3. The depth of texture shall be measured from the original concrete surface. Any projections above the original surface shall be removed by wire brushing or with the steel straightedge prior to taking a measurement on hardened concrete. If measurements are being made on fresh concrete, the depth gauge shall be pressed down until substantially at the level of the original concrete surface.

With the depth gauge guides in contact with the original concrete surface, the plunger is depressed until contact is made with the bottom of the groove in the concrete. The gauge is then removed

Figure 1

Depth Measuring Gauge

from the surface with care being taken to prevent the plunger from being disturbed. The texture depth is then read to the nearest 1/32 of an inch (1 mm) on the calibrated plunger. The plunger is then rezeroed and another depth measurement taken. This procedure is repeated until the necessary measurements are completed.

A sufficient number of random measurements shall be made throughout each day's operation to insure that the required texture depth is obtained.

Report

4. The depth of texture measured at a minimum of two locations per lot (or day's production if less than a lot) shall be recorded for each day's operation. At each of the locations, five measurements shall be taken transversely across the roadway. The individual readings and the average shall be recorded for each location.

Method of Test for

MEASUREMENT OF TEXTURE DEPTH BY SAND-PATCH

LDH Designation: TR 617-74

Scope

1. This method describes a procedure for determining the average texture depth of a selected portion of a pavement surface.

Apparatus

2. The apparatus shall consist of the following:

(a) Sand spreading tool consisting of a 2 ½ in. (63.5 mm) diameter flat wooden disc with a 1/16 in. (1.59 mm) thick hard rubber disc of the same diameter attached to one face and a short dowel serving as a handle attached to the other face.

(b) Metal cylinder with a volume of approximately 1.5 in.^{3} (24.6 cm^3).

(c) Natural silica sand from Ottawa, Illinois, graded to pass a No. 50 (.300 mm) sieve and retained on a No. 100 (.150 mm) sieve.

(d) Balance sensitive to .01 g.

(e) Ruler, 12 in. (305 mm) long, with markings in divisions of every 0.1 in. (2 mm).

(f) Wire brush and soft hand brush.

Procedure

3. (a) Normally a volume of 1.50 in.^{3} (24.6 cm^3) of sand is used in performing this test. This volume can be obtained by a cylinder 0.75 in. (19 mm) in inside diameter and 3.40 in. (86.4 mm) in height.

(b) If a volume other than 1.50 in.^{3}(24.6 cm^3) is desired, prepare a conversion table in which texture depths, T, can be determined for sand-patch diameters, D, ranging from 4 to 12 inches (100 to 306 mm) in increments of 0.1 in. (2 mm).

(1) Calculate the exact volume, V , of the metal cylinder prepared for this purpose.

(2) To prepare the conversion table, use the equation $T = \frac{4V}{\pi D^2}$

(c) Determine the weight of sand needed to fill the metal cylinder.

(1) Fill the cylinder to the top with dry sand and gently tap the base of the cylinder three times on a rigid surface. Add more sand to fill the cylinder again to the top and level the top with a straightedge.

(2) Determine the weight of sand in the cylinder. This weight of sand should be placed in suitable containers (35 mm film cans) and used for every sand-patch test. (The weight has been determined to be 38.83 grams for every 1.50in.^{3}[24.6cm^3]) If a balance is not available, the required amount of sand can be measured for each test by filling the metal cylinder according to the method described in Section 3c (1).

(d) The pavement surface selected for test must be dry. If the pavement has not been subjected to traffic, scrub the test surface with a wire brush to remove any loosely bonded particles or curing compounds that will be worn away by a small amount of traffic. Otherwise, the pavement surface should be swept with a soft hand brush.

(e) Pour the measured sand on the test surface and spread it with the rubber disc spreading tool into a circular patch with the surface depressions filled to the level of the peaks. The sand spreading tool should be kept flat on the surface and moved in a circular motion. Avoid losing any sand, especially during windy conditions. Sand used for one test should not be reused for another test.

(f) Measure the diameter of the sand-patch at five or more equally spaced locations and record to the nearest 0.1 in. (2 mm).

(g) For very smooth pavement surfaces where patch diameters are greater than 12 in. (305 mm), the diameter shall be listed as 12 in. (305 mm) plus and texture depth less than 0.013 in. (0.33 mm).

Calculation of Texture Depth

4. Compute the average diameter of the sand-patch and determine the texture depth by using the formula $T = \frac{4V}{\pi D^2}$, where:

V = Volume (in.^{3} or mm^3)
D = Sand patch diameter (in. or mm)
T = Texture depth (in. or mm)

Texture depths for a volume of 1.50 in.^{3}(24.6 cm^3) and diameters ranging from 4 to 12 inches (100 to 306 mm) in increments of 0.1 in. (2 mm) are given, in inches in Table I and in millimeters in Table II.

Reference

This test method is a modification of Test Method Tex-436-A, "Measurement of Texture Depth by the Sand-Patch Method," Texas Highway Department.

TABLE I

Texture Depth, in. (1.50 in. ^{3} volume)

D = Sand-patch diameter, in.
T = Texture depth, in.

D	T	D	T	D	T
4.0	0.119	6.7	0.043	9.4	0.022
4.1	0.113	6.8	0.041	9.5	0.021
4.2	0.108	6.9	0.040	9.6	0.021
4.3	0.103	7.0	0.039	9.7	0.020
4.4	0.098	7.1	0.038	9.8	0.020
4.5	0.094	7.2	0.037	9.9	0.019
4.6	0.090	7.3	0.036	10.0	0.019
4.7	0.086	7.4	0.035	10.1	0.019
4.8	0.083	7.5	0.034	10.2	0.018
4.9	0.080	7.6	0.033	10.3	0.018
5.0	0.077	7.7	0.032	10.4	0.018
5.1	0.074	7.8	0.031	10.5	0.017
5.2	0.071	7.9	0.031	10.6	0.017
5.3	0.068	8.0	0.030	10.7	0.017
5.4	0.065	8.1	0.029	10.8	0.016
5.5	0.063	8.2	0.028	10.9	0.016
5.6	0.061	8.3	0.028	11.0	0.016
5.7	0.059	8.4	0.027	11.1	0.016
5.8	0.057	8.5	0.026	11.2	0.015
5.9	0.055	8.6	0.026	11.3	0.015
6.0	0.053	8.7	0.025	11.4	0.015
6.1	0.051	8.8	0.025	11.5	0.014
6.2	0.050	8.9	0.024	11.6	0.014
6.3	0.048	9.0	0.024	11.7	0.014
6.4	0.047	9.1	0.023	11.8	0.014
6.5	0.045	9.2	0.023	11.9	0.013
6.6	0.044	9.3	0.022	12.0	0.013

TABLE II

Texture Depth, mm (24.6 cm ^{3} volume)

D = Sand-patch diameter, mm
T = Texture depth, mm

D	T	D	T	D	T	D	T
100	3.13	152	1.35	204	0.75	256	0.48
102	3.01	154	1.32	206	0.74	258	0.47
104	2.89	156	1.29	208	0.72	260	0.46
106	2.79	158	1.25	210	0.71	262	0.46
108	2.68	160	1.22	212	0.70	264	0.45
110	2.59	162	1.19	214	0.68	266	0.44
112	2.49	164	1.16	216	0.67	268	0.44
114	2.41	166	1.14	218	0.66	270	0.43
116	2.33	168	1.11	220	0.65	272	0.42
118	2.25	170	1.08	222	0.64	274	0.42
120	2.17	172	1.06	224	0.62	276	0.41
122	2.10	174	1.03	226	0.61	278	0.40
124	2.04	176	1.01	228	0.60	280	0.40
126	1.97	178	0.99	230	0.59	282	0.39
128	1.91	180	0.97	232	0.58	284	0.39
130	1.85	182	0.94	234	0.57	286	0.38
132	1.80	184	0.92	236	0.56	288	0.38
134	1.74	186	0.90	238	0.55	290	0.37
136	1.69	188	0.89	240	0.54	292	0.37
138	1.64	190	0.87	242	0.53	294	0.36
140	1.60	192	0.85	244	0.53	296	0.36
142	1.55	194	0.83	246	0.52	298	0.35
144	1.51	196	0.81	248	0.51	300	0.35
146	1.47	198	0.80	250	0.50	302	0.34
148	1.43	200	0.78	252	0.49	304	0.34
150	1.39	202	0.77	254	0.49	306	0.33