A Modification of the AASHO Road Test Serviceability Index Formula

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•USE of the CHLOE profilometer in Texas indicated that this device for measuring road roughness tends to rank pavements having a coarse-textured surface too low on the serviceability scale. To offset this tendency, a hand-operated device for measuring coarseness of texture was developed, and a term for textural roughness was added to the AASHO Road Test formula for the serviceability index. The coefficient of the new term was evaluated by analysis of the subjective ratings given 43 flexible pavements by a 12-man panel of Texas highway engineers.

The new formula for serviceability index predicted the adjusted ratings with satisfactory accuracy and will be used on this project for calculating the serviceability index for flexible pavements. It is anticipated that minor modifications will be required in the texturemeter, its use and the subsequent PSI equations as additional rating data are analyzed.

THE SERVICEABILITY INDEX FORMULA

The objectives of Research Project 2-8-62-32, "Application of the AASHO Road Test Results to Texas Conditions," require the calculation of the serviceability index of each flexible pavement test section from the following formula developed at the AASHO Road Test (2).

$$p = 5.03 - 1.91 \log_{10} (1 + \overline{SV}) - 0.01 \sqrt{C + P} - 1.38 \overline{RD}^2 \quad (1)$$

in which

- p = the present serviceability index;
- $\overline{SV}$ = the mean of the slope variance in the two wheelpaths, multiplied by 10^6;
- $C + P$ = a measure of cracking and patching in the pavement surface; and
- $\overline{RD}$ = a measure of rutting in the wheelpaths.

The serviceability index, p, is an estimate of the mean subjective rating which would be given the pavement by a cross-section of highway users, and represents the instantaneous ability of the pavement to serve high-speed, mixed traffic at the time it is rated (1).

The index (or the rating) is restricted to values from 0 to 5.0. The scale is divided into five categories (2) (Table 1).

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TABLE 1

Rating or Index	Description of Pavement
0 - 1	Very poor
1 - 2	Poor
2 - 3	Fair
3 - 4	Good
4 - 5	Very good

EFFECT OF SURFACE TEXTURE ON SLOPE VARIANCE

In Eq. 1 the term having the greatest effect on the serviceability index is the slope variance term, log $(1 + \overline{SV})$. Slope variance at the Road Test was measured by a specially developed instrument known as the AASHO Road Test profilometer. On the present project, slope variance is being measured by the CHLOE profilometer (3) an instrument also developed at the Road Test but not regularly used there (Figs. 1 and 2).

Use of the CHLOE profilometer on Texas pavements has shown that the slope variance arising from roughness of surface texture cannot be distinguished from that resulting from objectionable undulations in the pavement. (The Road Test profilometer was equipped with an electronic component which filtered out high frequency voltage fluctuations arising from roughness of surface texture.) As a result, the serviceability indexes computed from CHLOE profilometer readings are generally too low (roughness too high) for rough-textured pavements that otherwise exhibit no objectionable roughness. Chastain and Crawford (4) report the same problem encountered on a study of the CHLOE and several roughometers in South Dakota in 1962. Informal discussions indicate similar conditions from various other sources.

METHODS USED IN MODIFYING THE SERVICEABILITY INDEX FORMULA

There being no effective method known to the project staff for damping out the high frequency vibrations of the CHLOE profilometer slope wheel mechanism arising from rough-textured surfaces, it was decided to develop a hand-operated device for measuring roughness of surface texture, and to add to the Road Test serviceability formula a term for surface texture that would serve to correct the serviceability index when necessary.

Figure 1. CHLOE profilometer in use. Man behind profilometer records cracking, patching and rut depth, to be used with CHLOE and texturemeter data in calculating serviceability index. Profilometer is loaded in towing vehicle for travel between test sections.

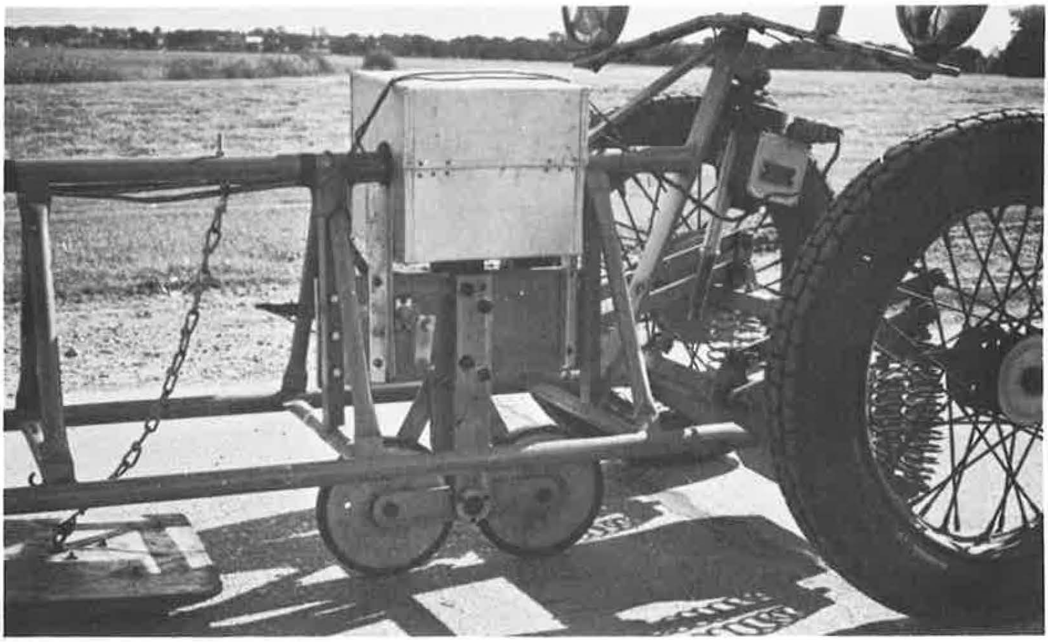

Figure 2. Close-up of slope wheels of CHLOE profilometer. Device measures angle between trailer tongue and link between slope wheels.

The instrument developed for measuring coarseness of texture is known as a texturemeter (Figs. 3 and 4), consisting essentially of a series of evenly spaced, parallel rods mounted in a frame. The rods can be moved longitudinally, independently of one another, against spring pressure. At either end of the series of movable rods is a fixed rod rigidly attached to the frame.

Each movable rod is pierced by a hole through which passes a taut cord (fiberglass-reinforced nylon), one end of which is fixed to the frame and the other to the spring-loaded stem of a 0.001-in. dial gage mounted on the frame. When the instrument is in use, the rods are held in a vertical position with their ends resting against the pavement surface. If the surface is smooth, the string will form a straight line and the dial will read zero. Any irregularities in the surface will cause the cord to form a zigzag line and will result in a reading on the dial. The coarser the texture of the pavement, the larger will be the dial reading.

The readings given by an instrument of this kind are affected by the spacing of the rods and the distance between the fixed supports. In the texturemeter now being used, the rods are spaced at $^5/_8$ in., and the instrument spans a distance of 10 in. between fixed supports. Some consideration was given to constructing the device with random spaced rods and there is probably some merit to this idea. It was generally decided, however, that the costs and trouble of such construction was not merited because the placement of the stones in the surfacing is itself a random factor. As the number of readings increases, the probability of such problems occurring continues to decrease.

It was postulated that the serviceability rating, R, of a test section could be estimated from the following mathematical model involving textural roughness:

$$R = p + A_0 + A_1 \log(1 + T) \qquad (2)$$

in which p is given by Eq. 1, T is the mean reading of the texturemeter in the two wheelpaths in thousandths of an inch, and A_0 and A_1 are constants to be determined by analysis of the subjective ratings given a number of selected test sections by a rating panel.

SELECTION AND RATING OF TEST SECTIONS

To provide ratings and other data required by the aforementioned analysis, forty-three 2,400-ft flexible pavement test sections in District 9 near Waco, for which CHLOE profilometer data were already available, were selected and rated by a 12-man panel in December 1962, and January 1963. Texture measurements on each section

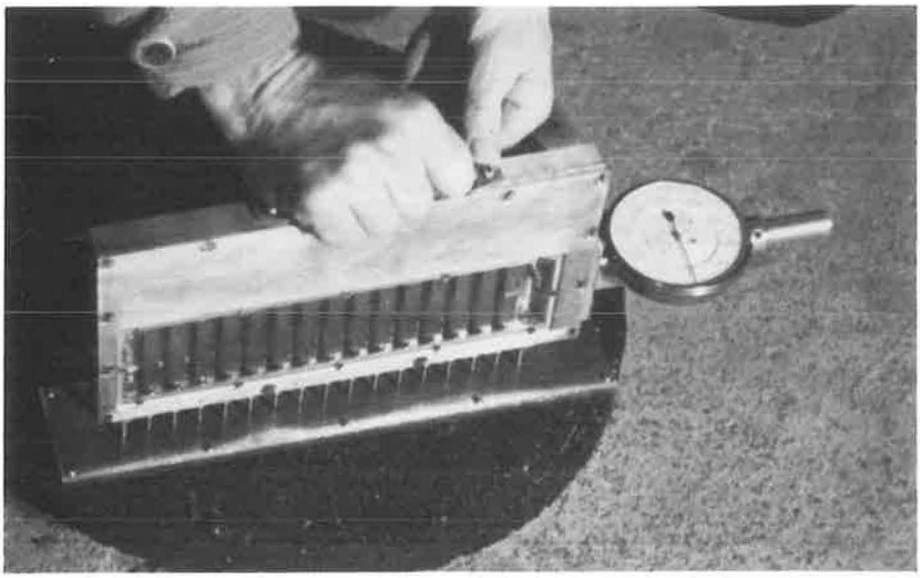

Figure 3. Texturemeter applied to flat, metal surface for zero reading.

Figure 4. Texturemeter applied to laboratory specimen of asphaltic concrete. Road surfaces give dial readings ranging from 0 to about 0.100 in.

were made in January 1963. Mean ratings, R, and texturemeter readings, T, are summarized in Table 2.

Each value of T in the table is the average of 40 readings by the texturemeter, 20 in each 2,400-ft wheelpath.

The rating R, of a section was calculated as follows:

An average of the 12 individual ratings was calculated. If one or more individual ratings deviated from the average by 0.8 or more, those ratings were eliminated, and the average of the remaining ratings was taken as the rating for the section. Under this procedure, the number of ratings averaged to obtain the mean for a section varied from 9 to 12, the most frequently occurring number being 11.

TABLE 2

Test Section	R	p	R - p	T	R′	p′	R′ - p′	p_c	Error (R′ - p_c)
(a) Asphaltic Concrete Surface									
15- 6-1	4.1	4.4	-0.3	2.4	4.5	4.2	0.3	4.4	0.1
15- 7-1	4.0	4.2	-0.2	4.0	4.4	4.1	0.3	4.5	-0.1
15- 7-2	3.8	3.9	-0.1	6.9	4.2	3.8	0.4	4.3	-0.1
15-14-1	3.9	4.0	-0.1	2.8	4.3	3.9	0.4	4.2	0.1
15-14-2	2.7	3.2	-0.5	1.4	3.0	3.2	-0.2	3.3	-0.3
15-14-3	3.6	4.6	-1.0	1.1	4.0	4.4	-0.4	4.5	-0.5
231- 3-1	3.9	4.3	-0.4	0.8	4.3	4.2	0.1	4.2	0.1
231- 4-1	4.0	4.4	-0.4	1.0	4.4	4.2	0.2	4.3	0.1
251- 1-1	3.3	3.5	-0.2	4.2	3.6	3.4	0.2	3.8	-0.2
251- 2-1	4.0	4.3	-0.3	2.0	4.4	4.1	0.3	4.3	0.1
251- 3-1	4.0	4.2	-0.2	3.9	4.4	4.0	0.4	4.4	0.0
258- 7-1	3.8	4.4	-0.6	0.3	4.2	4.2	0.0	4.1	0.1
258- 7-2	3.6	4.0	-0.4	0.0	4.0	3.9	0.1	3.7	0.3
258- 7-3	3.2	3.8	-0.6	0.1	3.5	3.6	-0.1	3.5	0.0
382- 2-1	3.8	3.6	0.2	2.2	4.2	3.5	0.7	3.7	0.5
183- 3-1	4.1	4.8	-0.7	3.8	4.5	4.4	0.1	4.8	-0.3
184- 3-1	4.0	4.6	-0.6	1.0	4.4	4.4	0.0	4.5	-0.1
209- 7-1	3.9	4.4	-0.5	1.9	4.3	4.3	0.0	4.5	-0.2
413- 2-1	4.0	4.5	-0.5	1.1	4.4	4.3	0.1	4.4	0.0
833- 4-1	4.0	4.6	-0.6	1.8	4.4	4.4	0.0	4.6	-0.2
833- 4-2	3.8	4.4	-0.6	1.8	4.2	4.2	0.0	4.4	-0.2
209- 3-1[1]	3.5	4.6	-1.1	3.2	3.9	4.4	-0.5	4.7	-0.8
209- 3-2[1]	3.6	4.6	-1.0	3.2	4.0	4.4	-0.4	4.7	-0.7
(b) Surface Treatments									
55- 2-1	3.5	2.3	1.2	31.9	3.9	2.3	1.6	3.3	0.6
209- 2-1	2.6	2.2	0.4	38.6	2.9	2.2	0.7	3.3	-0.4
386- 3-1	2.7	2.2	0.5	46.5	3.0	2.2	0.8	3.4	-0.4
386- 3-2	3.2	2.2	1.0	54.3	3.5	2.2	1.3	3.4	0.1
386- 4-1	2.6	2.1	0.5	25.0	2.9	2.1	0.8	3.1	-0.2
386- 4-2	2.6	2.1	0.5	12.0	2.9	2.1	0.8	2.8	0.1
398- 5-1	2.7	2.6	0.1	11.6	3.0	2.5	0.5	3.2	-0.2
519- 3-1	3.2	2.4	0.8	27.7	3.5	2.4	1.1	3.4	0.1
590- 2-1	3.1	2.6	0.5	10.9	3.4	2.6	0.8	3.3	0.1
836- 2-1	3.0	3.3	-0.3	2.1	3.3	3.2	0.1	3.4	-0.1
836- 2-2	3.0	2.8	0.2	1.6	3.3	2.8	0.5	3.0	0.3
1665- 1-1	2.5	1.8	0.7	43.2	2.8	1.8	1.0	3.0	-0.2
2305- 1-1	2.3	2.0	0.3	19.1	2.5	2.0	0.5	2.9	-0.4
2395- 1-1	2.6	2.3	0.3	5.0	2.9	2.3	0.6	2.7	0.2
656- 1-1	3.6	2.4	1.2	40.0	4.0	2.4	1.6	3.5	0.5
833- 7-1	3.4	2.5	0.9	19.2	3.7	2.4	1.3	3.3	0.4
1078- 2-1	3.5	2.8	0.7	14.5	3.8	2.8	1.0	3.6	0.2
2625- 1-1	3.5	2.8	0.7	25.6	3.8	2.8	1.0	3.8	0.0
1054- 4-1[1]	2.4	2.6	-0.2	29.4	2.6	2.6	0.0	3.6	-1.0
1594- 2-1[1]	2.5	2.8	-0.3	24.1	2.8	2.8	0.0	3.8	-1.0

[1]Data from this section not used in analysis.

ANALYSIS

For use in a regression analysis, Eq. 2 was rearranged

$$R - p = A_0 + A_1 \log (1 + T) \qquad (3)$$

Values of (R - p) were plotted as ordinates, and log (1 + T) as abscissa in Figure 5. Also shown in the figure is a plot of Eq. 4 obtained from the regression analysis

$$R - p = -0.77 + \log (1 + T) \qquad (4)$$

The squared correlation coefficient was 0.78 and the standard deviation was 0.28. Data for sections 209-3-1, 209-3-2, 1054-4-1, and 1594-2-1 were eliminated from this and the succeeding analysis as extreme values, because of the fact that the R - p values for these sections deviated from the values predicted by Eq. 4 by an amount considerably in excess of two standard deviations. The reason for the unusually low ratings—or unusually high serviceability indexes—for these sections was not apparent. As time permits, further study of these sections will be made.

ADJUSTMENT OF DATA

Eq. 4 shows that when T = 0, as for a very smooth-textured pavement, the serviceability index, p, exceeds the rating, R, by nearly 0.8 of a rating unit. Thus, in those instances where texture had no effect on the profilometer, either the subjective ratings were too low, or the serviceability indexes computed from the profilometer were too high, or both of these conditions existed.

It was obvious that most members of the rating panel were hesitant to rate any pavement in the "very good" category, as evidenced by the maximum panel mean of 4.1. It was the opinion of the authors (both former AASHO Road Test staff members) that

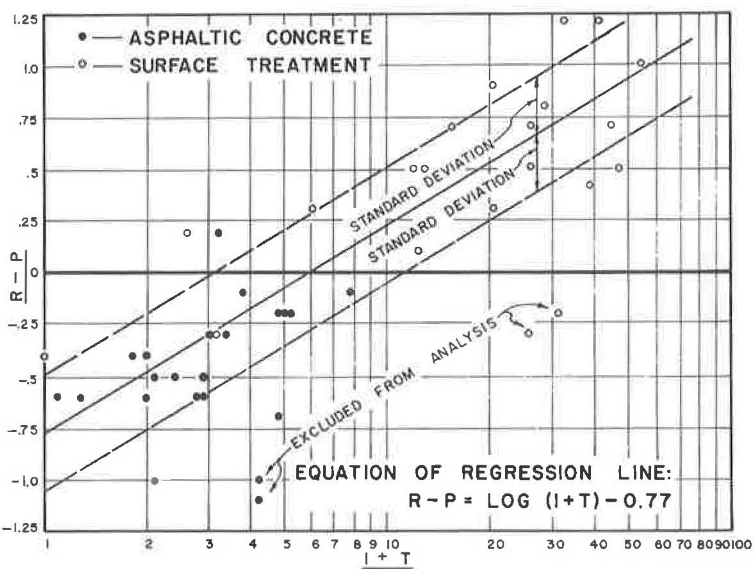

Figure 5. Difference between rating and serviceability index as a function of roughness of surface texture. Data are from Table 2.

the Road Test panel would have rated several of the District 9 pavements in the neighborhood of 4.5. To establish agreement between the national and the local panel, it was concluded that all local ratings should be adjusted upward by 10 percent, so that the maximum mean rating of 4.1 would be increased to 4.5, and other ratings would be increased proportionately. The column headed R′ in Table 2 gives the adjusted values of the rating.

On the other hand, examination of the profilometer data showed that this instrument had in several instances yielded serviceability indexes for subsections (1,200-ft half-sections) as high as 4.9 or 5.0. It was felt that these were too high, and that until the instrument could again be correlated with the Road Test profilometer, the serviceability indexes calculated from CHLOE data should be adjusted downward.

The original study correlating the CHLOE with the Road Test profilometer showed that a constant, 3×10^6, should be subtracted from the CHLOE slope variance in order to make its output agree with that of the Road Test instrument. This correction was used in calculating the values of serviceability, p, given in Table 2.

To achieve the desired reduction in serviceability index, the values of p′ given in Table 2 were calculated using a correction constant of 2.5×10^6. Values of p′ are somewhat less (one to two tenths, usually) than the corresponding values of p, when p is above 3.0. Below 3.0, the effect of the change in the correction constant is practically negligible.

ANALYSIS OF ADJUSTED DATA

A plot of R′ - p′ versus log (1 + T) is shown in Figure 6. The best fitting line through the data is

$$R' - p' = 0.18 + 0.81 \log (1 + T) \qquad (5)$$

The squared correlation coefficient was 0.70 and the standard deviation was 0.28. Eq. 5 may be written

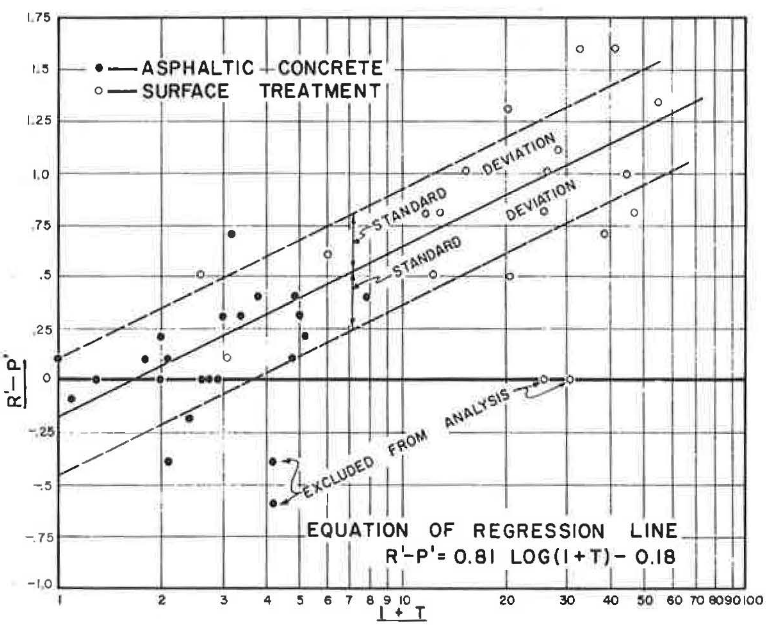

Figure 6. Difference between adjusted rating and adjusted serviceability index as a function of roughness of surface texture. Data are from Table 2.

$$R' = p' - 0.18 + 0.81 \log (1 + T) \quad (6)$$

in which p' is found from Eq. 1, and $\overline{SV}$ is the (CHLOE slope variance - 2.5) × 10^6.

Let p_c = the serviceability index corrected for surface texture.

Then according to Eq. 6

$$p_c = 4.85 - 1.91 \log (1 + \overline{SV}) + 0.81 \log (1 + T) - 0.01 \sqrt{C + P} - 1.38 \overline{RD}^2 \quad (7)$$

in which $\overline{SV}$ is the (CHLOE slope variance - 2.5) × 10^6 and all other terms are as previously defined.

According to the analysis of the adjusted data, Eq. 7 predicts the adjusted ratings (actual rating + 10%) with a root mean square residual of 0.28. This error compares favorably with the error of 0.38 reported for Eq. 1 in the reference previously cited, but would have been increased somewhat had the four sections eliminated from the analysis been included.

Values of p_c computed from Eq. 7 are given in the next to last column of Table 2. Prediction errors are shown in the last column.

The small study reported here is by no means conclusive. Experience at the Road Test indicated that the initial rating session for any rating panel may be somewhat erratic due to variations in rating technique as the study progresses. Since the analysis of this data, this equipment has subsequently participated in a nationwide correlation and rating session at Purdue University under the auspices of the NCHRP. The results of that test are presently being analyzed and will be reported, at which time it may be desirable to rerun this analysis to include that data. The arbitrary adjustment of the data must also be checked.

CONCLUSIONS

The following conclusions appear to be justified by the data and analysis presented here:

1. The local rating panel seemed to rate pavements at a slightly lower level than the AASHO Road Test rating panel. The tendency was most noticeable in the case of pavements in the "very good" category.
2. The texturemeter or a similar device is a necessary tool for use with the CHLOE profilometer on coarse-textured pavements such as surface treatments.
3. The modified formula for the serviceability index (Eq. 7) is believed to be satisfactory for the purposes of this project and should be used for calculating the serviceability index of flexible pavements in lieu of the original AASHO Road Test formula (Eq. 1), inasmuch as about one-half of the flexible pavement test sections have a coarse-textured surface.
4. The CHLOE profilometer in use on this project should again be correlated with the AASHO Road Test profilometer. If the correlation between the two instruments is found to have changed, it may be necessary to make corresponding changes in the coefficients of Eq. 7.

RECOMMENDATIONS

The authors realize that the instrument developed and discussed herein is empirical and that changes in its design and/or construction can affect the results. Three models of the texturemeter have already been built in Texas. Model 2 is the model described in Appendix B. A second instrument was constructed from these plans for the South Dakota Highway Department. Appendix C compares the output of the two instruments.

It is recommended that some measuring device such as the texturemeter be used in conjunction with the CHLOE profilometer if accurate PSI estimates are to be obtained. Additional modification and improvements of the present device are encouraged.

ACKNOWLEDGMENTS

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The texturemeter was designed by staff members working in cooperation with Josef Budig, Scientific Instrument Maker, Research and Instrument Shop, Texas Engineering Experiment Station, who constructed the first experimental model. The model used in this study was constructed in the Texas Highway Department's Equipment Division shops under the supervision of Paul Hancock. W. R. Hudson of the Highway Department contributed valuable suggestions leading to improvements in the second model.

Members of the rating panel were J. E. Kelly, S. P. Gilbert, G. C. Cleveland, John Neubauer, R. E. Burns, W. W. Miller, and John Nichols, all of District 9 of the Highway Department; W. R. Hudson, John Nixon, and P. B. Rapstine of the Highway Design Division; F. H. Scrivner and E. L. Hlavaty of the project staff.

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Appendix A

RELATION OF TEXTUREMETER READING TO SLOPE VARIANCE

Because the texturemeter is designed to provide a correction to be applied to the slope variance measured by the CHLOE profilometer, it is of interest to investigate the relationship between slope variance and the texturemeter reading.

When the texturemeter is placed in contact with a pavement surface, the string takes a shape which approximates the shape of the surface (Fig. 7). The dial gage of this 5-probe texturemeter would measure the difference between the straight-line distance, AB, and the total length of the broken line. That is, the dial would read the difference, Δ, in

$$\Delta = h_1 + h_2 + h_3 + h_4 - AB \tag{8}$$

In the more general case of a texturemeter with n + 1 probes,

$$\Delta = \sum_{i=1}^{n} h_i - AB \tag{9}$$

The corresponding slope variance is calculated as follows:

Let θ_i be the angle between the string segment connecting probe (i - 1) and probe i. The slope of this segment is $\tan \theta_i$. The variance, σ^2, is

$$\sigma^2 = \left(\frac{1}{n - 1}\right)\left[\sum_{i=1}^{n} \tan^2 \theta_i + \frac{1}{n} \sum_{i=1}^{n} \tan \theta_i\right] \qquad (10)$$

In Figure 7 it may be seen that

$$\tan \theta_3 = \frac{a_3}{b} \qquad (11)$$

in which $a_3 = Y_3 - Y_2$, and b is the spacing of the probes.

In general, then

$$\tan \theta = \frac{Y_i - (Y_i - 1)}{b} \qquad (12)$$

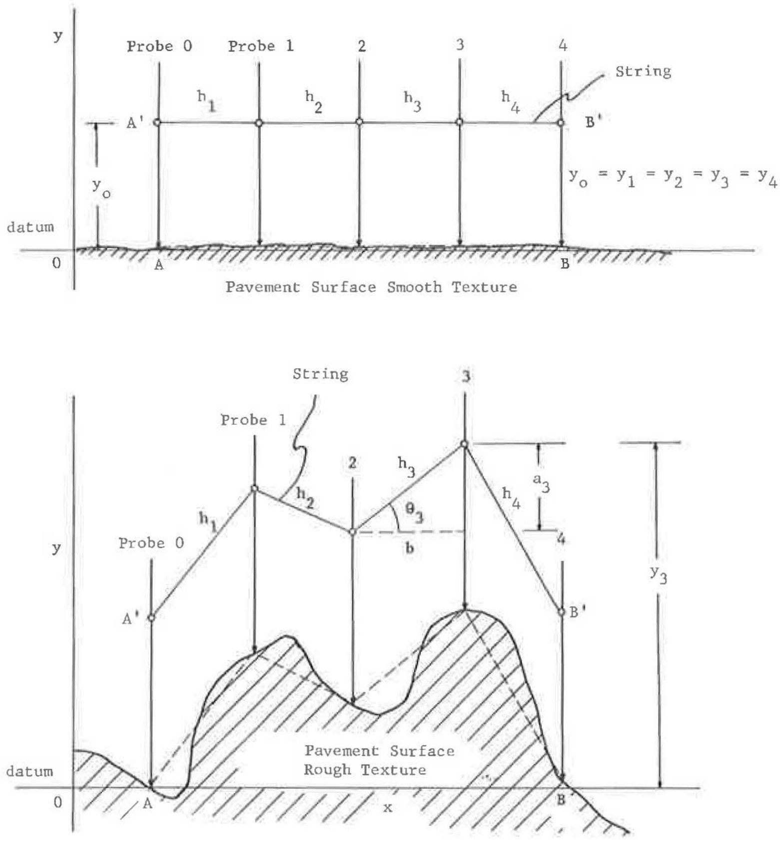


Figure 7. Schematic of a 5-probe texturemeter. The string, parallel to the dashed lines connecting the probe points, approximates shape of pavement surface.

and

$$\sum_{i=1}^{n} \tan \theta_i = \frac{1}{b} \sum_{i=1}^{n} (Y_i - Y_{i-1}) \tag{13}$$

For the 5-probe texturemeter (Fig. 7), n = 4 and

$$\sum_{i=1}^{4} (Y_i - Y_{i-1}) = Y_1 - Y_0 + Y_2 - Y_1 + Y_3 - Y_2 + Y_4 - Y_3 = Y_1 + Y_4$$

But $Y_1 = Y_4 = 0$, as may be seen in Figure 7. Therefore

$$\sum_{i=1}^{4} (Y_i - Y_{i-1}) = 0$$

Then in the general case

$$\sum_{i=1}^{n} (Y_i - Y_{i-1}) = 0 \tag{14}$$

According to Eqs. 10 and 14, the slope variance is

$$\sigma^2 = \frac{\sum_{i=1}^{n} \tan^2 \theta_i}{n - 1} \tag{15a}$$

From Eqs. 12 and 15 it is seen that

$$\sigma^2 = \frac{\sum_{i=1}^{n} (Y_i - Y_{i-1})^2}{b^2 (n - 1)} \tag{15b}$$

Now $(Y_3 - Y_2)^2 = h_3^2 - b^2$, as may be seen by reference to the right triangle shown in Figure 7. Therefore, in the general case

$$(Y_i - Y_{i-1})^2 = h_i^2 - b^2$$

Therefore

$$\sigma^2 = \frac{\sum_{i}^{n} h_i^2}{b^2 (n - 1)} - \frac{n}{n - 1} \tag{16}$$

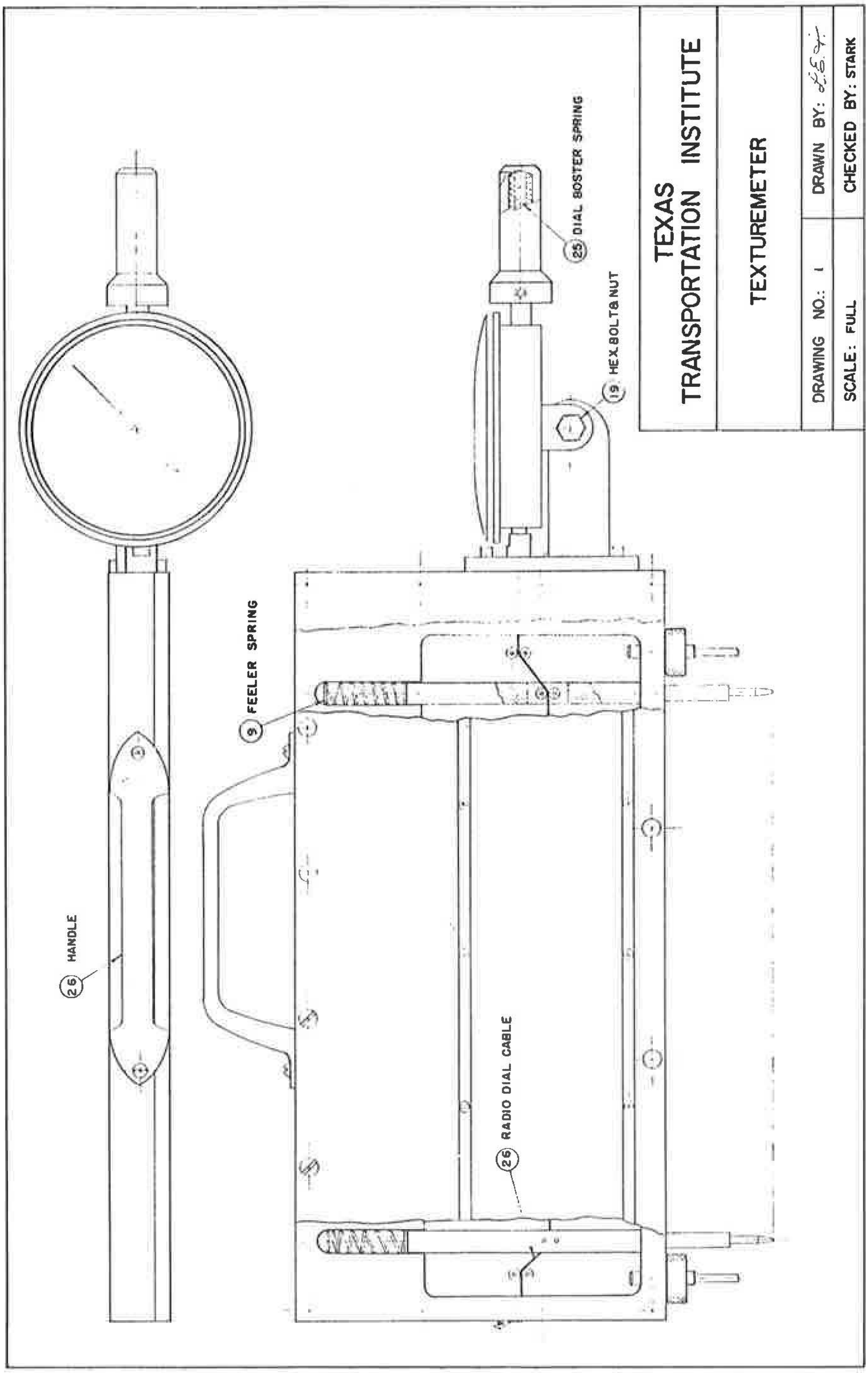
By comparing the slope variance, σ^2, given in Eq. 16, with the texturemeter reading, Δ, given in Eq. 9, it can be seen that both quantities are functions of the variable, h. Therefore, a correlation exists between the slope variance of the pavement surface from point A to point B, and the reading of the texturemeter in the same area.

Appendix B

PLANS AND PARTS LIST FOR TEXAS TEXTUREMETER MODEL 2

PARTS LIST

Part No.	Name	No. Required	Material
1	Body	1	AL
2	Cover	1	AL
3	Window	1	PL
4	Feeler	15	Brass
5	Point	15	Steel
6	Drill Rod, $\frac{1}{16} \times 0.325$	30	Steel
7	Cable Roller	30	Brass
8	Control Roller	4	Brass
9	Feeler Spring	15	0.314 O.D., 0.023 Gage
10	Ames Dial No. 482	1	
11	Dial Bracket	1	Steel
12	$\frac{3}{32} \times \frac{1}{8}$ Flat HD Set SCR	10	BR
13	$\frac{3}{16} \times \frac{1}{2}$ Flat HD Set SCR	14	BR
14	$\frac{1}{8} \times \frac{3}{8}$ Round HD SCR	1	BR
15	$\frac{3}{16} \times \frac{1}{4}$ Round HD SCR	2	BR
16	$\frac{3}{16} \times 1''$ Allen SCR Knurled	2	ST
17	Bushing	1	BR
18	Dial Protector	1	AL
19	$\frac{1}{4} \times \frac{1}{2}$ HEX HD Bolt & Nut	1	ST
20	Lock Nut Knurled	2	BR
21	Reference Pin	2	ST
22	$\frac{3}{16} \times \frac{1}{8}$ Set SCR	2	ST
23	Dial Foot	1	BR
24	Dial Booster Spring	1	0.245 O.D., 0.022 Gage
25	Handle	1	BR
26	0.025 Radio Dial Cable	1	No. 75A - 100 Nylon
27	Drill Rod $\frac{1}{16} \times \frac{3}{4}$	4	ST
28	Base Plate	1	CRS
29	Base Cover	1	AL
30	$\frac{1}{8} \times \frac{1}{4}$ Round HD SCR	8	BR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TRANSPORTATION INSTITUTE
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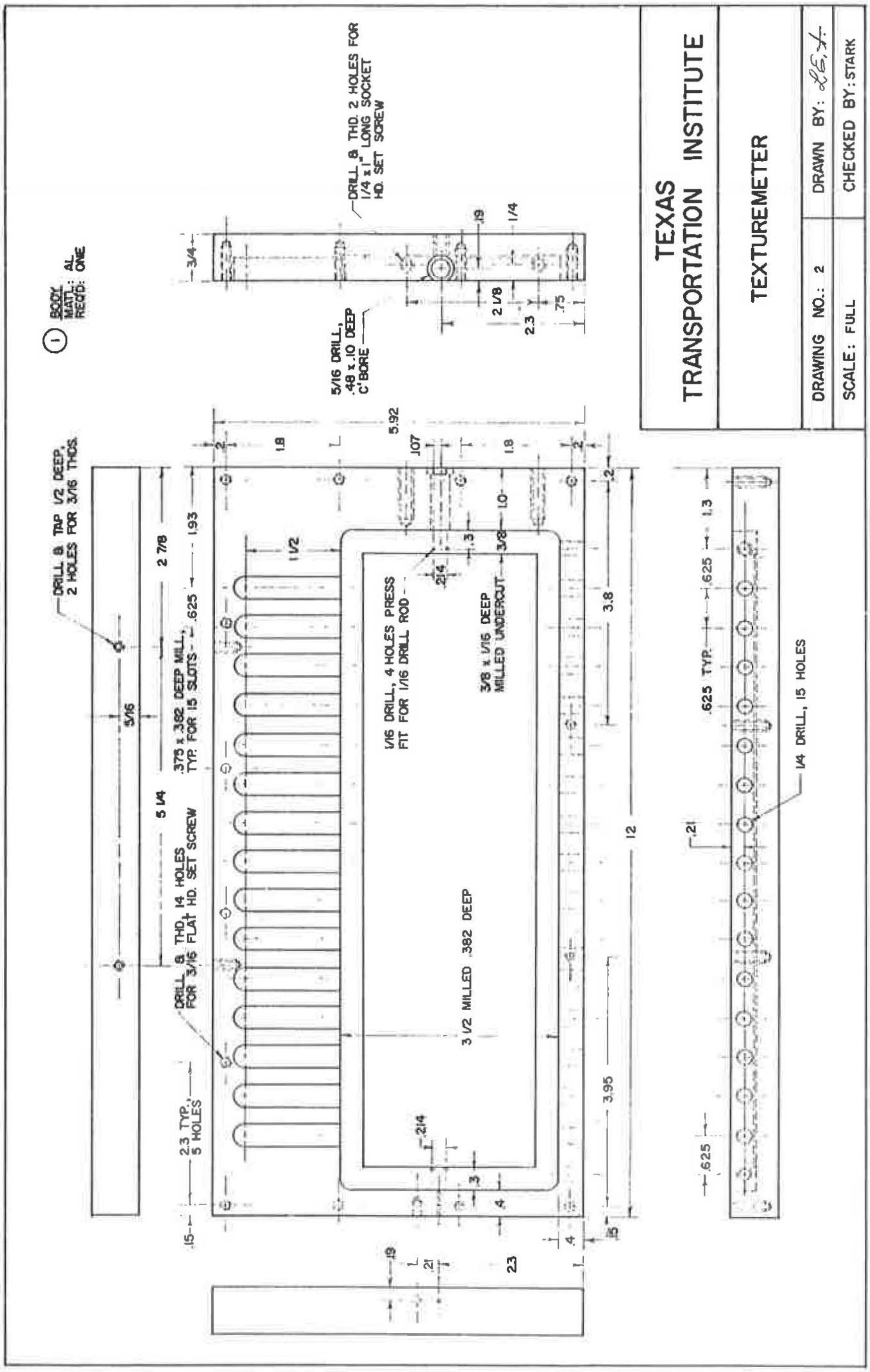
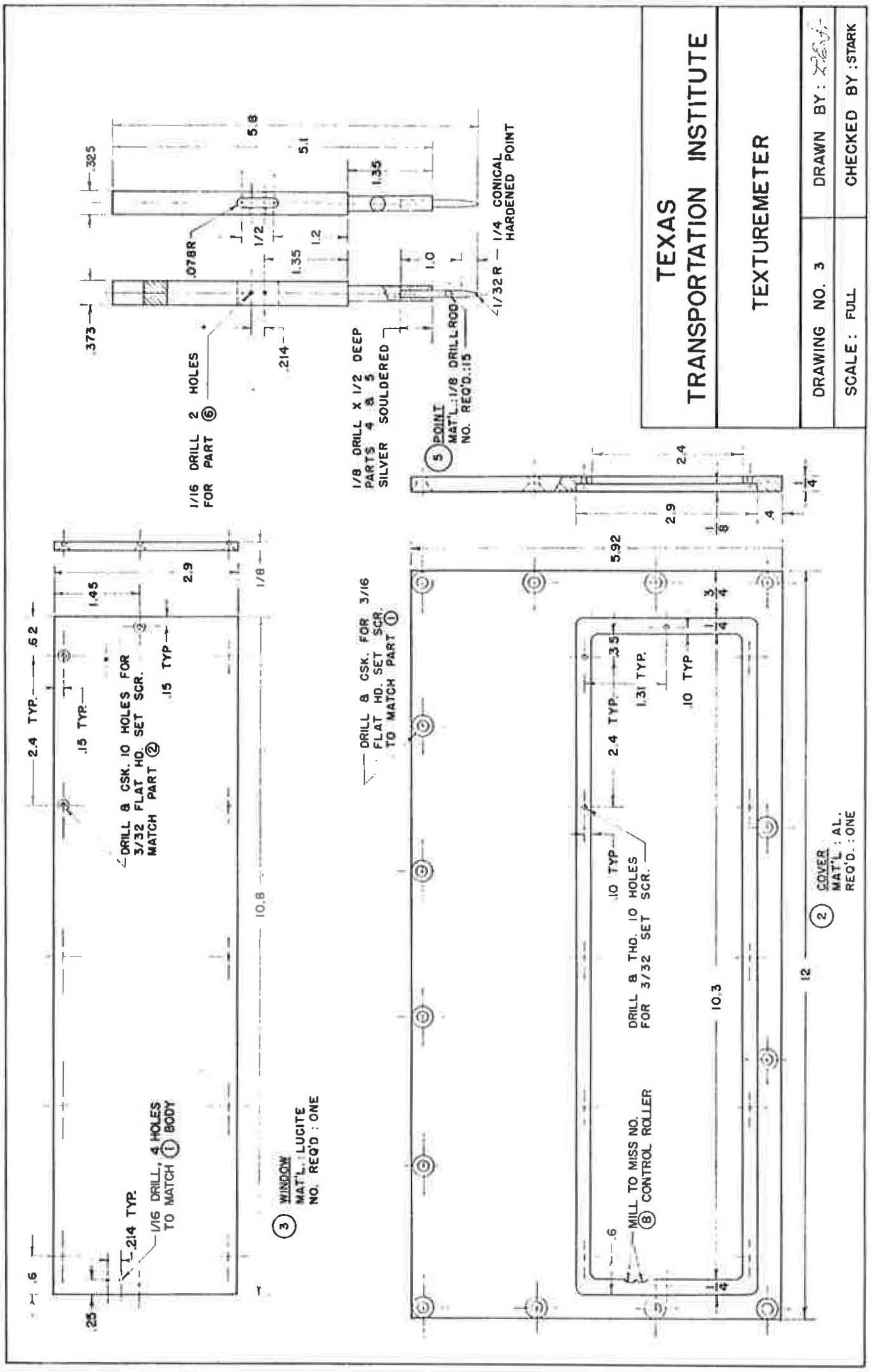
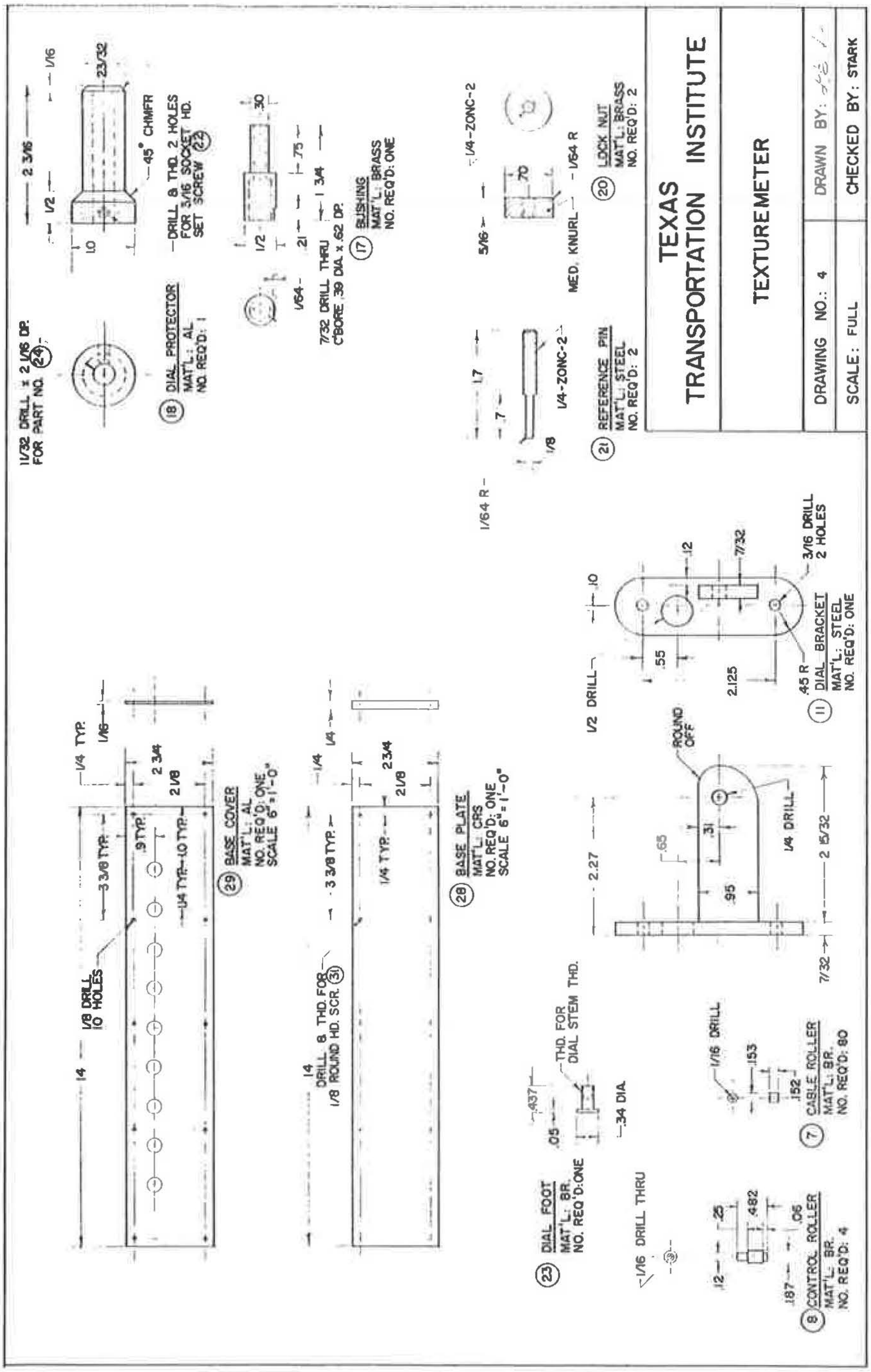
25 DIAL BOSTER SPRING
19 HEX.BOLT & NUT
9 FEELER SPRING
26 HANDLE
26 RADIO DIAL CABLE



TEXAS TRANSPORTATION INSTITUTE
TEXTUREMETER
DRAWING NO.: 2
SCALE: FULL
DRAWN BY:
CHECKED BY: STARK
1 BODY MATL: AL REQ'D: ONE
DRILL & TAP 1/2 DEEP, 2 HOLES FOR 3/16 THDS.
DRILL & THD. 14 HOLES FOR 3/16 FLAT HD. SET SCREW
.375 x .382 DEEP MILL, TYP. FOR 15 SLOTS
2.3 TYP. 5 HOLES
1/16 DRILL, 4 HOLES PRESS FIT FOR 1/16 DRILL ROD
3/8 x 1/16 DEEP MILLED UNDERCUT
3 1/2 MILLED .382 DEEP
5/16 DRILL, .48 x .10 DEEP C'BORE
DRILL & THD. 2 HOLES FOR 1/4 x 1" LONG SOCKET HD. SET SCREW
1/4 DRILL, 15 HOLES
.625 TYP.


TEXAS
TRANSPORTATION INSTITUTE
TEXTUREMETER
DRAWING NO. 3
SCALE : FULL
DRAWN BY :
CHECKED BY : STARK
③ WINDOW
MAT'L : LUCITE
NO. REQ'D : ONE
DRILL & CSK. 10 HOLES FOR 3/32 FLAT HD. SET SCR. MATCH PART ②
1/16 DRILL, 4 HOLES TO MATCH ① BODY
② COVER
MAT'L : AL.
REQ'D : ONE
DRILL & CSK. FOR 3/16 FLAT HD. SET SCR. TO MATCH PART ①
DRILL & THD. 10 HOLES FOR 3/32 SET SCR.
MILL TO MISS NO. ⑧ CONTROL ROLLER
⑤ POINT
MAT'L : 1/8 DRILL ROD
NO. REQ'D : 15
1/16 DRILL 2 HOLES FOR PART ⑥
1/8 DRILL X 1/2 DEEP PARTS 4 & 5 SILVER SOULDERED
1/4 CONICAL HARDENED POINT


TEXAS
TRANSPORTATION INSTITUTE
TEXTUREMETER
DRAWING NO.: 4
SCALE: FULL
DRAWN BY:
CHECKED BY: STARK
DIAL PROTECTOR
MAT'L: AL
NO. REQ'D: 1
BUSHING
MAT'L: BRASS
NO. REQ'D: ONE
REFERENCE PIN
MAT'L: STEEL
NO. REQ'D: 2
LOCK NUT
MAT'L: BRASS
NO. REQ'D: 2
BASE COVER
MAT'L: AL
NO. REQ'D: ONE
SCALE 6" = 1'-0"
BASE PLATE
MAT'L: CRS
NO. REQ'D: ONE
SCALE 6" = 1'-0"
DIAL BRACKET
MAT'L: STEEL
NO. REQ'D: ONE
DIAL FOOT
MAT'L: BR.
NO. REQ'D: ONE
CABLE ROLLER
MAT'L: BR.
NO. REQ'D: 80
CONTROL ROLLER
MAT'L: BR.
NO. REQ'D: 4
11/32 DRILL x 2 1/16 DP. FOR PART NO. 24
DRILL & THD. 2 HOLES FOR 3/16 SOCKET HD. SET SCREW 22
45° CHMFR
7/32 DRILL THRU C'BORE .39 DIA. x .62 DP.
1/4-20NC-2
MED. KNURL
1/8 DRILL 10 HOLES
DRILL & THD. FOR 1/8 ROUND HD. SCR. 31
1/2 DRILL
3/16 DRILL 2 HOLES
1/4 DRILL
ROUND OFF
THD. FOR DIAL STEM THD.
.34 DIA
1/16 DRILL THRU
1/16 DRILL

Appendix C

COMPARISON OF TWO TEXTUREMETERS

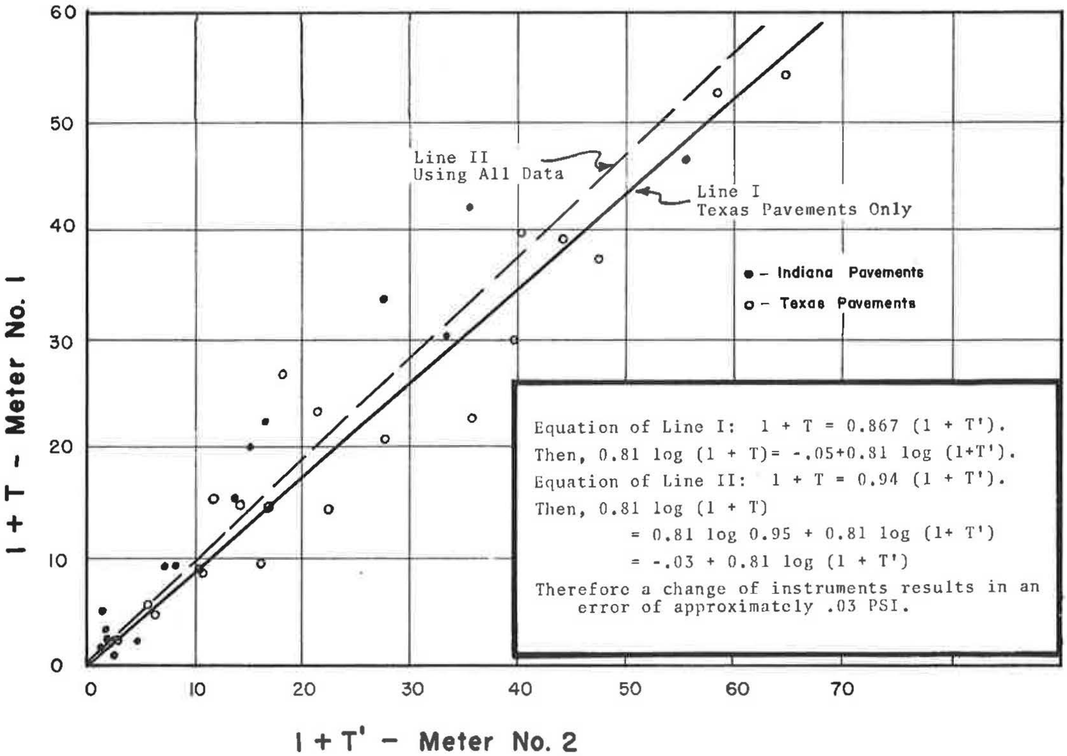


Figure 8. Comparison of two texturemeters.