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MACRO-TEXTURE, FRICTION, CROSS SLOPE AND WHEEL TRACK DEPRESSION MEASUREMENTS ON 41 TYPICAL TEXAS HIGHWAY PAVEMENTS

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Macro-Texture, Friction, Cross Slope and Wheel Track Depression Measurements on 41 Typical Texas Highway Pavements

by

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Abstract

The role of macro-texture in imparting friction capabilities to pavement surface is of major concern to researchers. Macro-texture is but one of the many variables affecting the interaction at the tire-pavement interface; however, at present its **relative** importance is questioned.

Friction tests obtained at 20, 40, and 60 mph with the Texas Highway Department research skid trailer, and macro-texture tests utilizing four different methods were conducted on forty-one pavement surfaces. These surfaces exhibited widely different friction levels, friction-speed gradients, drainage capabilities, mineralogical properties, and texture classifications.

Macro-texture values obtained with the five methods used are compared. The effects of macro-texture types and magnitudes on friction numbers and friction-speed gradients are analyzed. Statistical analyses and typical plots are given. Brief descriptions of several macro-texture measurement methods which have or are being used by various agencies in the United States and other countries are presented.

For the treaded tire and 0.020-inch water film thicknesses used in this study, macro-texture was found to have little effect on friction level, but did have some influence on the percent decrease in friction with increase in speed.

Pavement cross slope and wheel track depression measurements were taken. Cross slope values are compared with recommended AASHO guidelines. On the average, cross slopes on the Texas pavements included in this study were found to be flatter than those recommended by AASHO. Based on measurements made on the various pavements included in this study, wheel track depression or pavement rutting is not a serious problem in Texas.

Objectives

The phase of the research reported had four objectives as summarized below:

1. Analyze and compare different methods for measuring pavement surface macro-texture. Both volumetric and mechanical roughness detector methods were used for assessing macro-texture levels.

2. Determine effects of macro-texture types and magnitudes on friction numbers and friction-speed gradients of various pavement surface types.

3. Survey the normal range of macro-texture existing on Texas pavements for use in a subsequent study of the effects of variable macro-texture on water depth buildup for various levels of pavement cross slopes and rainfall intensities.

4. Measure normal range of cross slopes and wheel track depressions existing on Texas pavements. Cross slope comparisons with recommended guidelines were to be made. These are also for use in a subsequent study of the effects of variable cross slopes on water depth buildup for various levels of pavement macro-textures and rainfall intensities.

Summary of Findings and Results

1. Statistical correlation analyses of five different procedures used to determine macro-texture indicate a high degree of linear correlation between the results of the different proce-

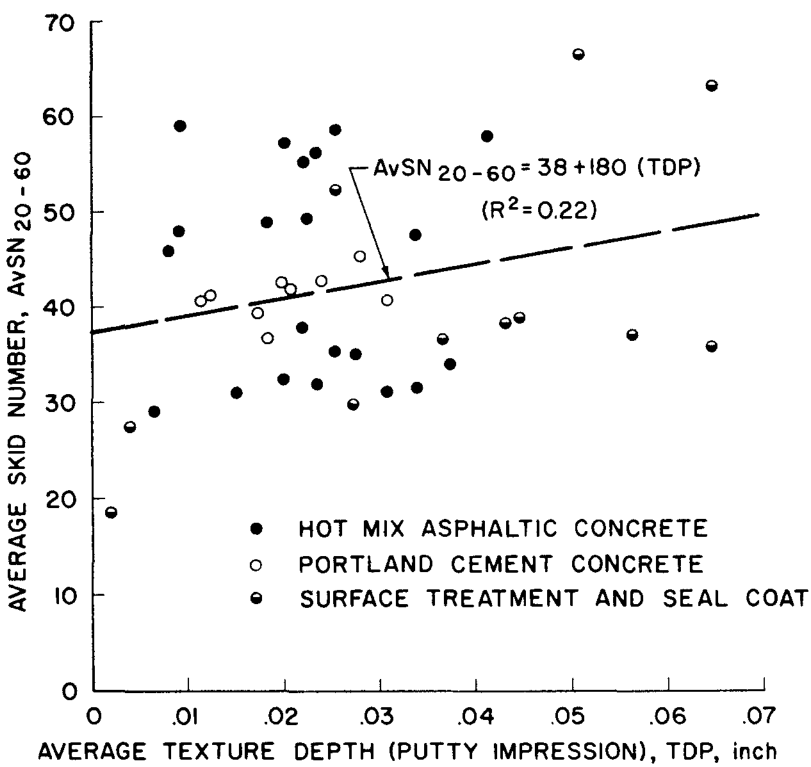
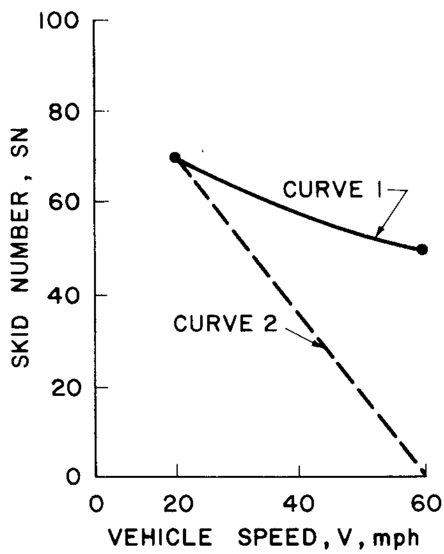


Figure 1. Average skid number versus macro-texture.

dures, with the coefficient of determination, R^2, ranging from 0.59 to 0.86. The coefficient of determination is the most commonly used statistical parameter for measuring the degree of association of two linearly dependent variables, and may vary from 0 to 1. If there is no linear relationship, $R^2 = 0$. The greater the value of R^2, the greater is the linear correlation. With the high degree of correlation shown by the results, one procedure may be used to predict values of macro-texture to be expected for the other procedure with excellent accuracy.

2. Statistical correlation analyses of skid numbers for a water film depth of approximately 0.02 inches with macro-texture on the 41 surfaces tested gave extremely low values of R^2, ranging from a low of 0.009 to a high of 0.22. For this water film thickness, macro-texture values within the range studied should not be used to predict values of skid numbers. Figure 1., a plot



$$\text{GRADIENT (G)} = \frac{SN_{20} - SN_{60}}{40}$$

$$\text{GRADIENT } (G_2) = \frac{SN_{20} - 0}{40}$$

$$\text{PERCENTAGE GRADIENT (PG)} = \frac{G}{G_2} \times 100 = \frac{SN_{20} - SN_{60}}{SN_{20}} \times 100$$

Figure 2. Gradient and percentage gradient calculations.

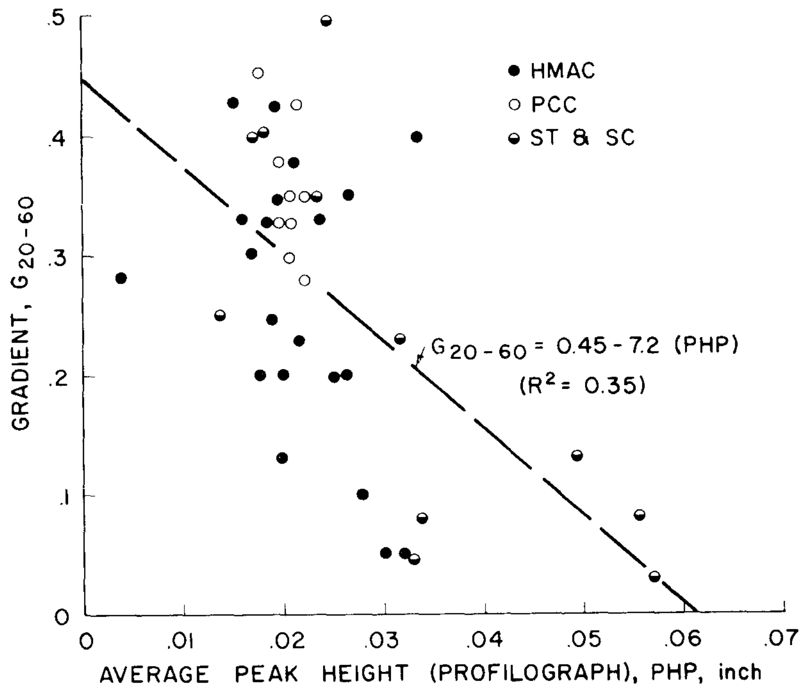


Figure 3. Gradient versus macro-texture.

of average skid number versus macro-texture, shows graphically the low degree of correlation between macro-texture and skid number of the surfaces included in this study.

3. Statistical correlation analyses of gradient with macro-texture measures gave values of R^2 ranging from 0.03 to 0.35 for a simple linear regression model. The procedure used to compute the gradient is shown on Figure 2. Figure 3., a plot of gradient versus average peak height by the profilograph method, shows the scatter of the plotted points about the regression line. From this plot it can be seen that only a rough estimate of gradient can be made from macro-texture measurements.

4. Statistical correlation analyses of percentage gradient (defined in Figure 2) and macro-texture gave values of R^2 that ranged from 0.28 to 0.52. The points are still scattered about the regression line (see Figure 4) and only a fair estimate of the gradient may be made from a measure of the macro-texture. It does appear from the plot of percentage gradient versus macro-texture that a macro-texture of over 0.035 inches will assure a relatively low percentage gradient, whereas macro-textures generally less than 0.035 inches will not assure a low percentage gradient.

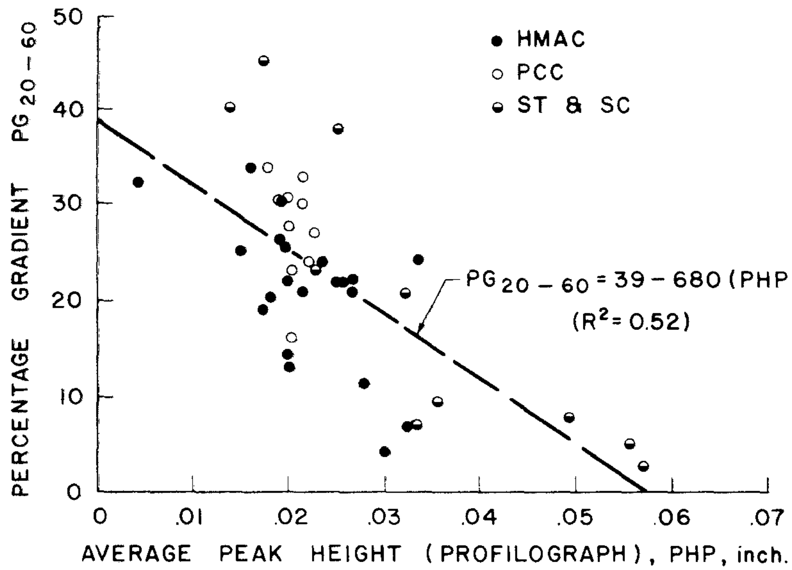


Figure 4. Percentage gradient versus macro-texture.

5. It would appear from the cross slope data obtained in this study that an increase in pavement cross slope is desirable.

6. Only a few scattered instances of significant wheel path depressions were noted on the pavements observed.

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