EFFECTS OF PAVEMENT SURFACE CHARACTERISTICS AND TEXTURES ON SKID RESISTANCE

SUMMARY REPORT
of
Research Report Number 138-4
Research Study Number 2-8-69-138

Cooperative Research Program of the
Texas Transportation Institute and the Texas Highway Department
In Cooperation with the
U. S. Department of Transportation, Federal Highway Administration

March, 1971

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Effects of Pavement Surface Characteristics and Textures on Skid Resistance

by

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Abstract

Data are presented relating the various pavement surface characteristics, operating modes of tires, and field methods of measuring skid numbers for different pavement surfaces. Void areas were determined for 41 pavement surfaces and correlated with the reduction in skid numbers caused by an increase in speed from 20 to 60 mph. The correlation coefficients were statistically significant. Void areas of highway surfaces can be increased by increasing the macro-textures of the surface to obtain small decreases in skid number with increased speed. Microscopic textures and small-scale macroscopic textures (in terms of centerline average heights) are also significantly correlated with the skid number measured by a skid trailer equipped with a standard E-17 test tire.

Equations are provided to permit predictions of the skid numbers at 20 mph from the texture parameters of pavement surfaces. Reduction in the skid number due to increasing speed may also be predicted by equations involving the void areas at the tire-pavement interface. Thus, the data presented offer a means of pre-evaluation of the expected skid characteristics of pavements.

Summary

The research reported includes a literature review and an experimental program conducted under Research Study 2-8-69-138, "Vehicle-Pavement Interaction." The purpose of the research was to determine the relationships between skid numbers and small-scale pavement textures combined with macrotexture parameters.

By means of multiple regression analyses, skid numbers were related to independent variables consisting of small-scale textures, macrotextures, and aggregate size. The equipment consisted of a locked wheel trailer conforming essentially to ASTM E-274 and standard skid test tires (ASTM E-249) both with and without tread. In general, pavement surfaces with rounded aggregates can be characterized by surfaces with hemispherical protrusions; surfaces with crushed aggregates can be characterized by surfaces with pyramidal protrusions.
Microtextures and small-scale macrotextures (in terms of centerline average height up to 1000 microinches) were significantly correlated with 20 mph skid numbers measured with a standard skid trailer. Macrotextures and aggregate particle size factors improve the correlation coefficients. A correlation coefficient, $R$, of 0.867 was obtained by relating the skid number at 20 mph to independent variables consisting of: (1) the small-scale textures ($t_u$) measured on aggregate particles by the Clevite BL-185 Surfindicator, (2) macro-texture ($T_{pro}$) measured by the Texas Highway Department Profilograph, and (3) the weighted particle-size factor (WPS).

**Results**

Estimates of $SN_{E20}$ as measured with a standard locked-wheel skid trailer, may be made from tentative empirical equations by using the average results of: (1) the Surfindicator textures taken on the surface and the Profilograph textures, or (2) the Surfindicator textures taken on exposed aggregates, Profilograph textures, and the weighted particle-size factor. The tentative equations are:

1. $SN_{E20} = 0.053t_u^{1.109} T_{pro}^{-0.093}$
2. $SN_{E20} = 1.725t_u^{0.523} T_{pro}^{-0.144} (WPS)^{-0.291}$

where

$SN_{E20}$ = skid number measured with the E-17 tire and at the speed of 20 mph,

$t_u$ = Surfindicator texture measured on the surfaces,

$t_u$ = Surfindicator texture measured on exposed aggregate particles,

$T_{pro}$ = Profilograph texture, and

WPS = weighted particle-size factor.

The percent decrease in skid number caused by an increase in the skidding speed from 20 to 60 mph, $G$, may be estimated by any one of the following empirical equations:

1. $G_1 = 223.748(0.002369)$
2. $G_2 = 146.304(0.002569)$
3. $G_3 = 79.106(0.046095)$
4. $G_4 = 118.518(0.011774)$
where

\[ G = \text{percent decrease in skid number, and} \]

\[ A_v = \text{total void area that includes the void area of the tire grooves and the pavement surface void area.} \]

The surface void area is determined from the Profilograph texture, texturemeter texture, modified sand-patch texture, or the putty impression texture for the first, second, third, and the fourth equation, respectively.

The tabulated correlation coefficients for four regression analyses are presented in Tables 2 through 5 of the full report.

The published version of the complete report of which this is a summary may be obtained by addressing your request as follows:

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