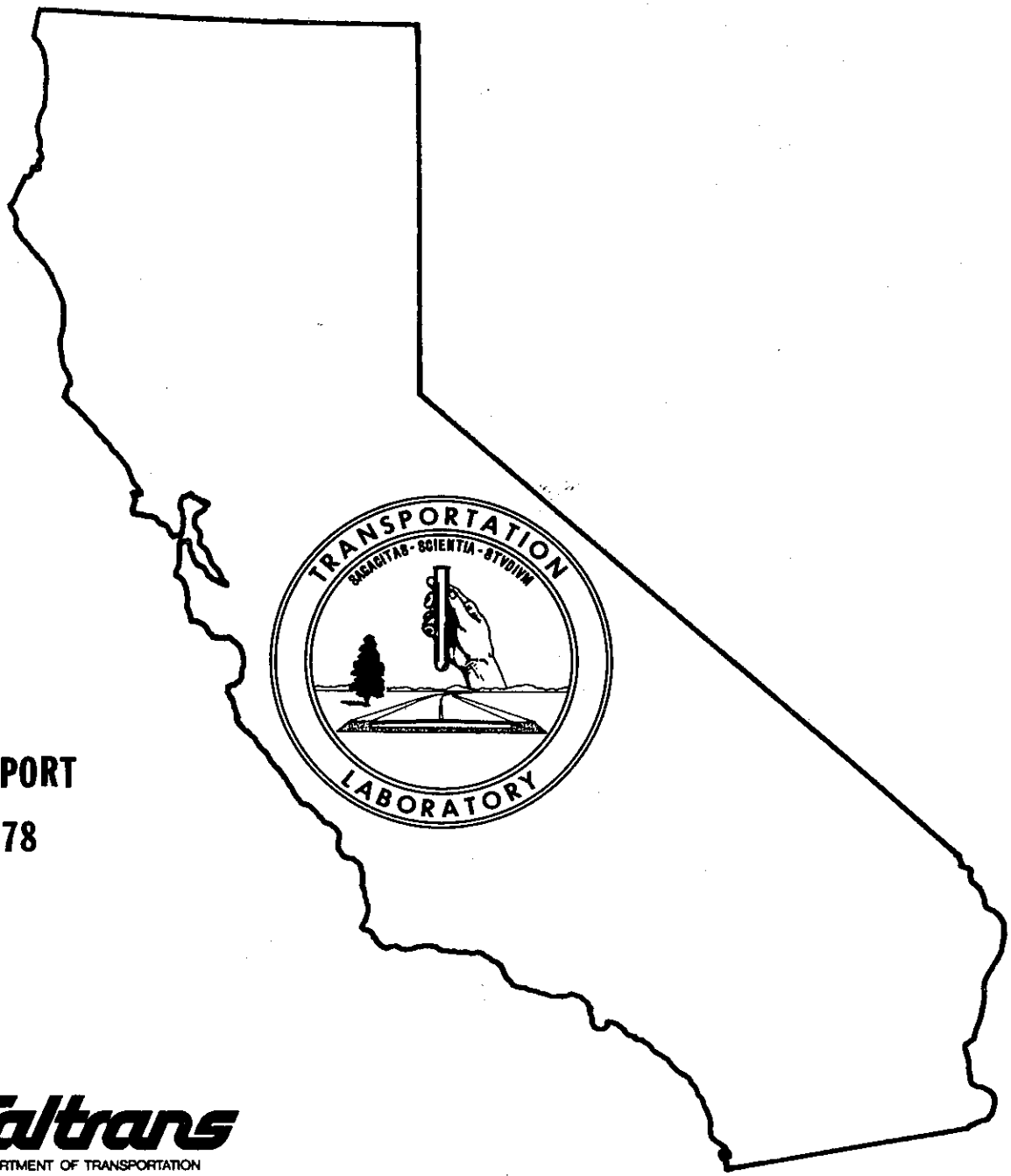
REPORT NO. CA-TL-78-19

THE EFFECT OF PAVEMENT GROOVING ON SKID RESISTANCE



FINAL REPORT

JUNE 1978

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CALIFORNIA DEPARTMENT OF TRANSPORTATION

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STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF CONSTRUCTION
OFFICE OF TRANSPORTATION LABORATORY

June 1978

TL No. 641139B

Mr. C. E. Forbes
Chief Engineer

Dear Sir:

I have approved and now submit for your information this final research project report titled:

THE EFFECT OF PAVEMENT GROOVING
ON SKID RESISTANCE

Study made by . . . . . Roadbed & Concrete

Under the Supervision of . . . . . D. L. Spellman

Principal Investigator . . . . . J. A. Matthews

Co-Investigator . . . . . B. D. Murray

Report Prepared by . . . . . B. D. Murray

Very truly yours,

George A. Hill

GEORGE A. HILL
Chief, Office of Transportation Laboratory

Attachment

BDM:lb

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INTRODUCTION

California has been grooving concrete pavements since the early 1960's to prevent accidents. A 1972 study (1) indicated that grooving certain sections of roadway has yielded in a two year period a:

1. 20 percent reduction in total accidents
2. 50 percent reduction in fatal accidents
3. 70 percent reduction in wet pavement accidents

These results were based on thirty-nine roadway locations that had been grooved. It must be recognized that one of the reasons for selecting the locations to be grooved was that these pavements exhibited high wet weather accident rates.

DISCUSSION

Grooving is considered most beneficial in reducing accidents, as it increases lateral control of vehicles which is often more important than stopping distance. Grooving is also effective in reducing hydroplaning which can induce skidding accidents. It has been well established that grooving has reduced accidents due to the reasons cited above; however, the effect of grooving on the skid resistance measured parallel to the direction of grooving using the Standard ASTM Towed Trailer has not been extensively examined and reported on.

The purpose of this work was to perform an overall analysis of skid test results from numerous pavements which have been grooved. Four hundred and fifty-seven test sections were located on twelve different highway routes throughout the State which had been tested for skid resistance prior to and following grooving. The

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data was evaluated using a diagonal regression procedure based on least squares linear regression analysis principles applied to variables that are not free of error. This diagonal regression line can be obtained using the equation:

$$\frac{Y-m_y}{\sigma_y} = \frac{X-m_x}{\sigma_x}$$

where m_y, m_x are the means and σ_y^2 and σ_x^2 the variances of y and x respectively.

Basically this method yields that regression line which can be visualized as obtained by performing two linear regression analyses. The first analysis the "before" grooving skid numbers are treated as dependent variables and the "after" grooving skid numbers as independent variables. The second analysis requires treating the "before" grooving skid numbers as the independent variables and the "after" grooving skid numbers as the dependent variables. The regression line obtained in the first analysis is plotted using routine procedures. The regression line obtained from the second analysis is plotted with the x - y axis reversed. It is noted that these two lines cross at the mean point for both before and after grooving skid numbers. The small angle between the two regression lines is then bisected in proportion to the estimated standard deviations of the "before" and "after" skid number data and the correlation line constructed.

Using the aforementioned statistical method the data was evaluated in three separate groupings. The first group represented the northern half of the state while the second group represented the southern half of the state. The data was then combined into the third group and evaluated as representative of the entire state. The difference between the north and south state is not significant

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and as such a statewide relationship can be used. The final linear correlation line for the combined north/south state group is presented in Figure 1.

This relationship indicates that on the average the skid number increases from three to five points when a pavement is grooved, with the greater increase corresponding to those pavements with the higher skid numbers prior to grooving. On a percentage basis the higher skid number pavements prior to grooving, increase approximately 8% to 10% with grooving. Those pavement with low skid numbers prior to grooving generally increase 14% to 16% in skid number with grooving.

The aforementioned results are averages and just that. One estimated standard deviation about the correlation line is 5.85 skid number points. As an example 95% of the pavement with a "before" grooving skid number of 30 will have an "after" grooving skid number in the approximate range of 22 to 46 with an average of 34.

CONCLUSIONS

In summary, skid tests made parallel to the grooving do not reflect the improvement in lateral control. Skid numbers as measured by the ASTM Towed Trailer do not show any dramatic changes in longitudinal skid resistance parallel to traffic following grooving. The average skid resistance measurements can vary more due to seasonal variations in the traffic contaminants (road grime, oil, agricultural products) present on the pavements than that from grooving. It appears that grooves ground parallel to traffic, only slightly improved longitudinal skid resistance and as such should not be used solely for improving longitudinal skid resistance. In many cases it is the loss of lateral control that appears to be a dominant cause of skidding accidents (one car accidents, for example) as compared to "rear-end" type collisions.

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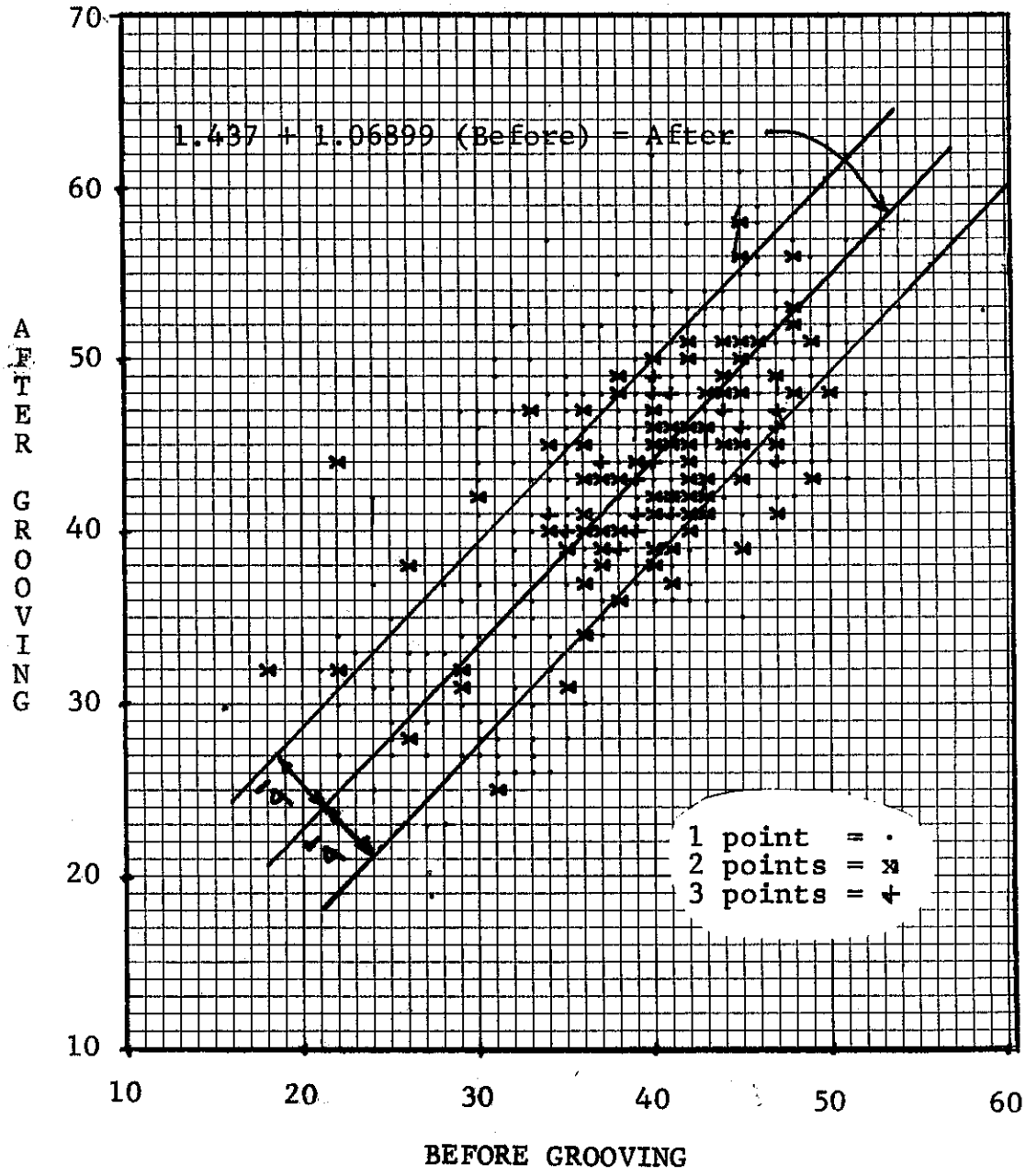
FIGURE 1.



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REFERENCE

1. "A Study of the Effects of Grooving on Motor Vehicle Accidents", James A. Moe, Director of Public Works, January 1972.

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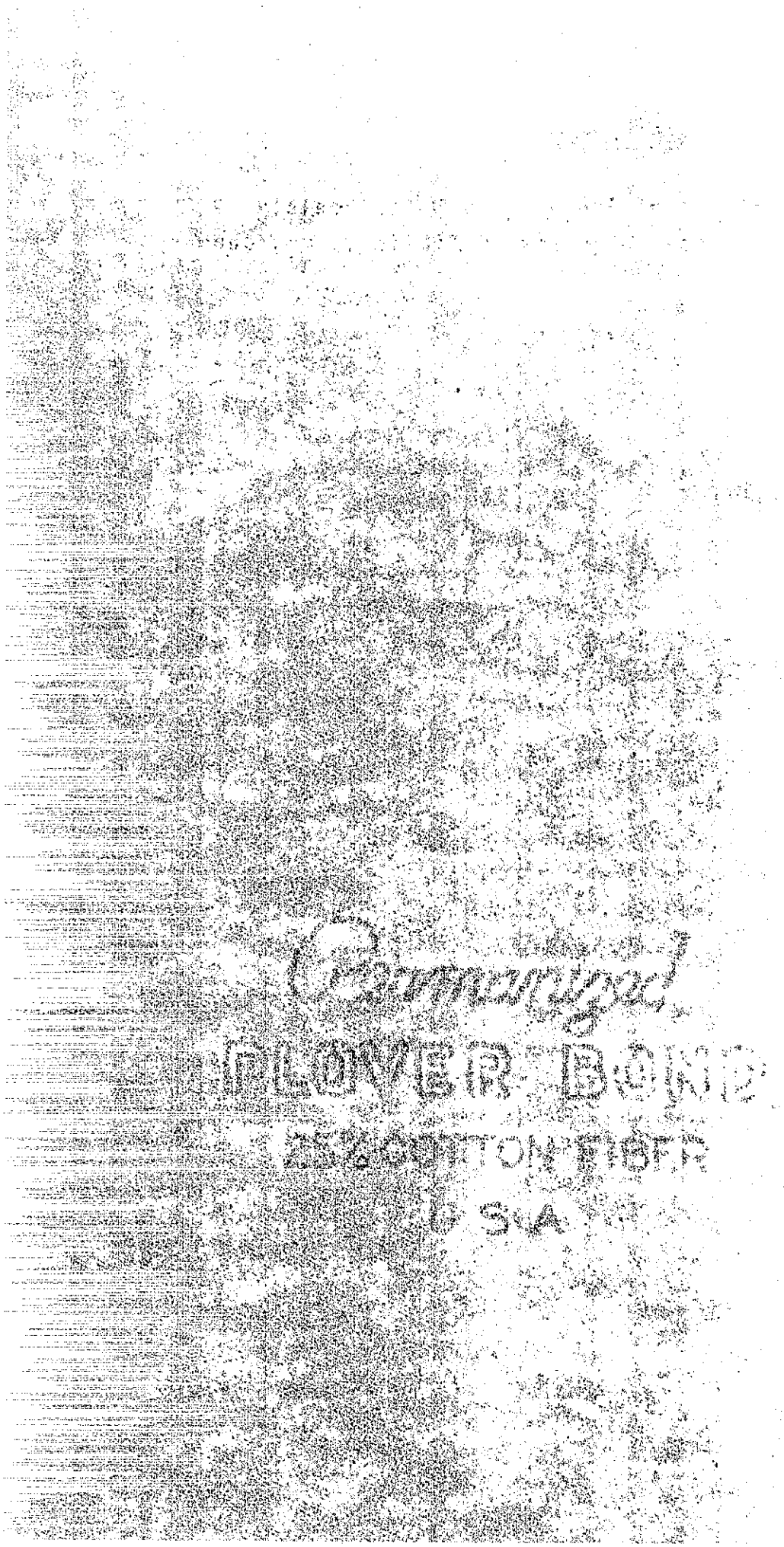

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