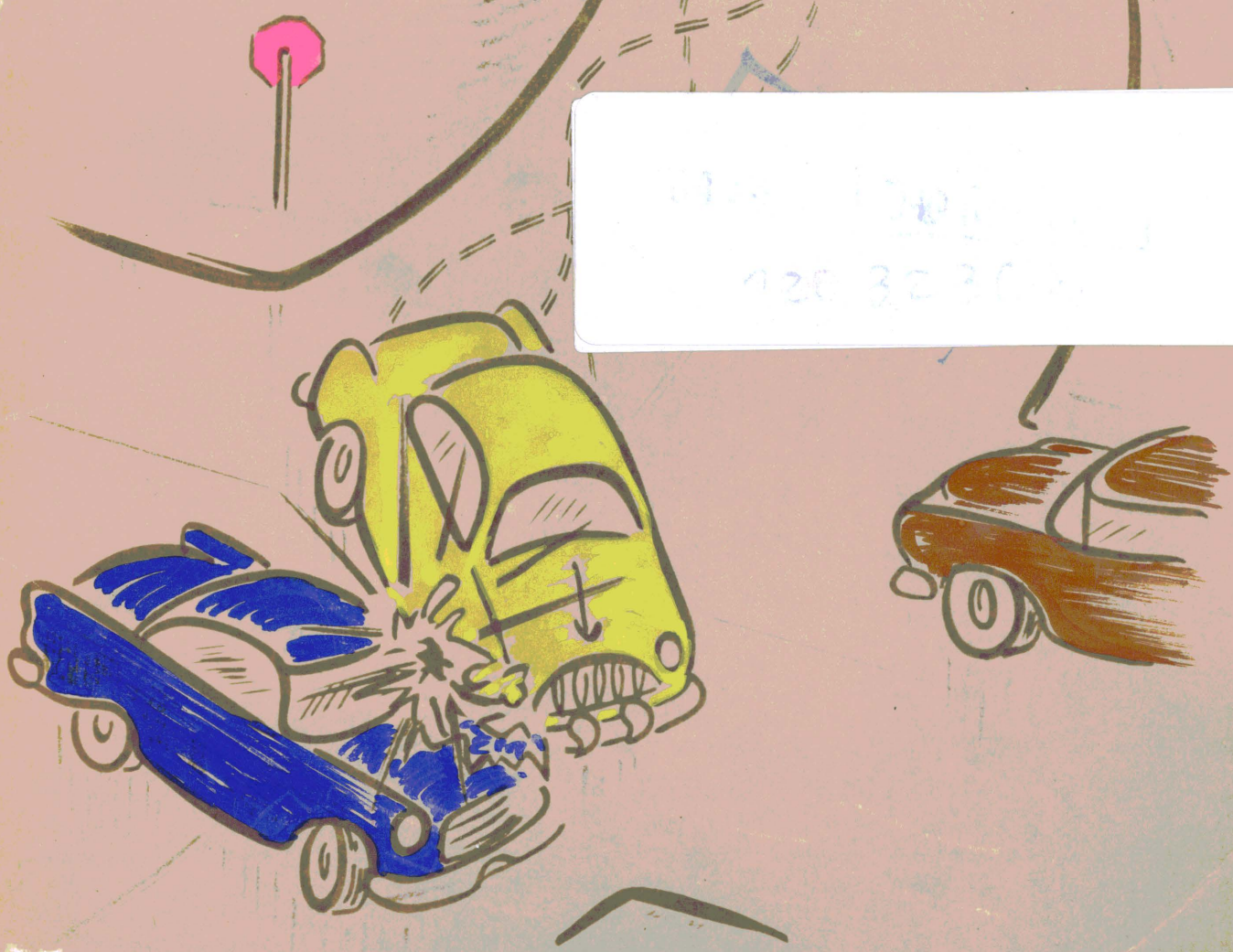
GROOVING

SLICK PAVEMENTS



SLICK PAVEMENT

Prepared And Compiled By
District 15

H. F. Hilgers
District Designing Engineer

SLICK PAVEMENT

I. INTRODUCTION:

Slick Pavement - Still a very dangerous driving condition that develops on our highways in spite of the modern construction materials and techniques. The slick condition of highway pavements will no doubt always be a problem, since the engineer, for reasons of economy, must use local materials available to the fullest extent. Often this local material is composed of soft aggregates that have a very high percent of wear under the present high speed and heavy volume highway traffic.

The method of correcting the slick riding surface of our highway pavement presents a problem that deserves careful consideration by all concerned. Additional research work is needed by the various material manufacturers, the several pavement associations, and highway departments in order to correct the condition, if possible, during the original construction.

Within recent years color contrast has entered into the design of the more important highways. There is a very definite need of this color differential between riding surface and the surface shoulder area. A concrete pavement riding surface should have surface shoulders of a contrasting black color, such as asphaltic concrete pavement. The same is true of an asphaltic concrete pavement riding surface; the shoulders should be surfaced with a white material, generally an asphalt surface treatment with white aggregate. It is also very

important that the original color contrast be maintained throughout the life of the highway, which feature is often overlooked during the usual maintenance work performed on the road in the years to follow.

In general the problem of slick asphalt pavements is fairly easy to correct if certain original basic design requirements are overlooked. A seal coat application of asphalt and hard aggregate of the proper color will generally provide a non-skid surface for a period, depending on the affinity of the original surface to asphalt. This corrective procedure is also within sound economical limits, since the cost is reasonable and it is possible to apply the seal coat under fairly heavy traffic conditions. From the investigations made by this District, it appears that the asphalt slurry also has possibilities in skid proofing pavements. At present the method of applying this material presents some problems to the usual maintenance construction practices.

Concrete pavement that has become slick presents a very different problem, since the affinity of concrete for asphalt is very unpredictable. Due to the white surface of the concrete, a method or material that will maintain this original color should be used.

Also, in line with the slick condition that develops on concrete pavement, the Engineer asks the question, why? There seems to be several features in concrete pavement construction that should be investigated by the Highway Department Research Section. Is the "belt finish" now given to concrete pavement adequate, or should we use some type of broom or scratch finish? Are the aggregates used

FIGURE NO. 1

FIGURE NO. 1A

in some parts of the State too soft for the traffic speeds and loads they are being subjected to? Is the cement factor too low? Is there a way of building into the original pavement the skid resistant features required,or is this an expense that will have to be met at a later date? Since any corrective measures done at a later date will no doubt have to be performed under heavy traffic conditions, is an increased initial construction cost justified?

II. SLICK CONCRETE PAVEMENT:

The problem in District 15 is considerable mileage of concrete pavement on the Interstate Highway System within San Antonio that has maintained its original smooth riding surface, the pavement is structurally sound, but the riding surface is slick and has the texture of polished marble. See Figure No. 1 showing the surface texture of this pavement. This general condition is on all of the concrete pavement, the only variance being in the degree of smoothness, which seems to be dependent on the length of time the particular section has been open to traffic.

III. INTERSTATE HIGHWAY 35

The section of this highway between the N. Flores St. overpass and the Broadway overpass had reached a condition where corrective measures had to be taken in order to try to lower the accident rate. See Figure 2 for tabulation of accidents and Figure 3 for average daily traffic volumes. It will be noted that the accident rate is appreciably higher when the pavement surface is wet.

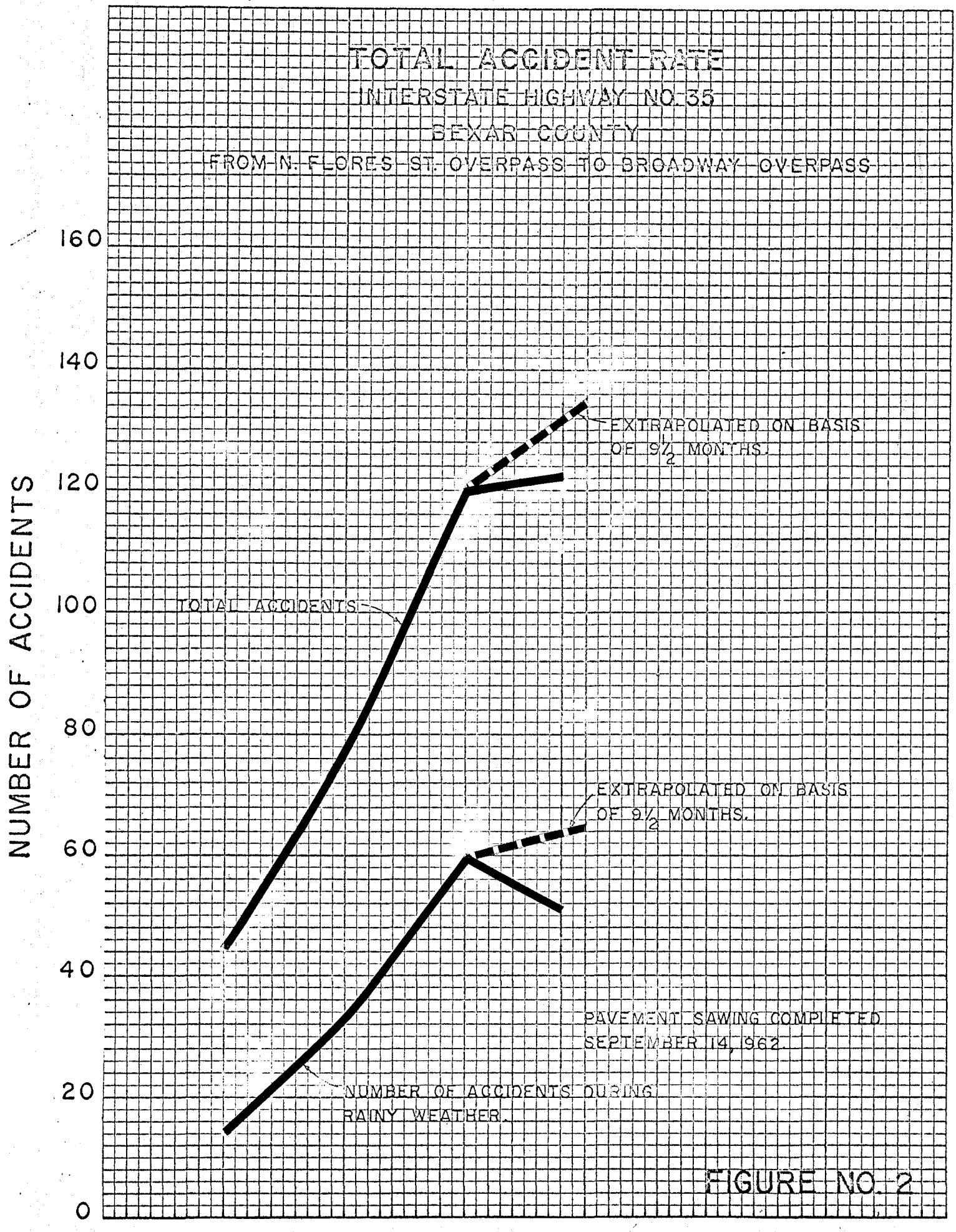

TOTAL ACCIDENT RATE
INTERSTATE HIGHWAY NO. 35
BEXAR COUNTY
FROM N. FLORES ST. OVERPASS TO BROADWAY OVERPASS
NUMBER OF ACCIDENTS
160
140
120
100
80
60
40
20
0
1959
1960
1961
1962
EXTRAPOLATED ON BASIS OF 9½ MONTHS.
TOTAL ACCIDENTS
EXTRAPOLATED ON BASIS OF 9½ MONTHS.
PAVEMENT SAWING COMPLETED SEPTEMBER 14, 962
NUMBER OF ACCIDENTS DURING RAINY WEATHER.

FIGURE NO. 2

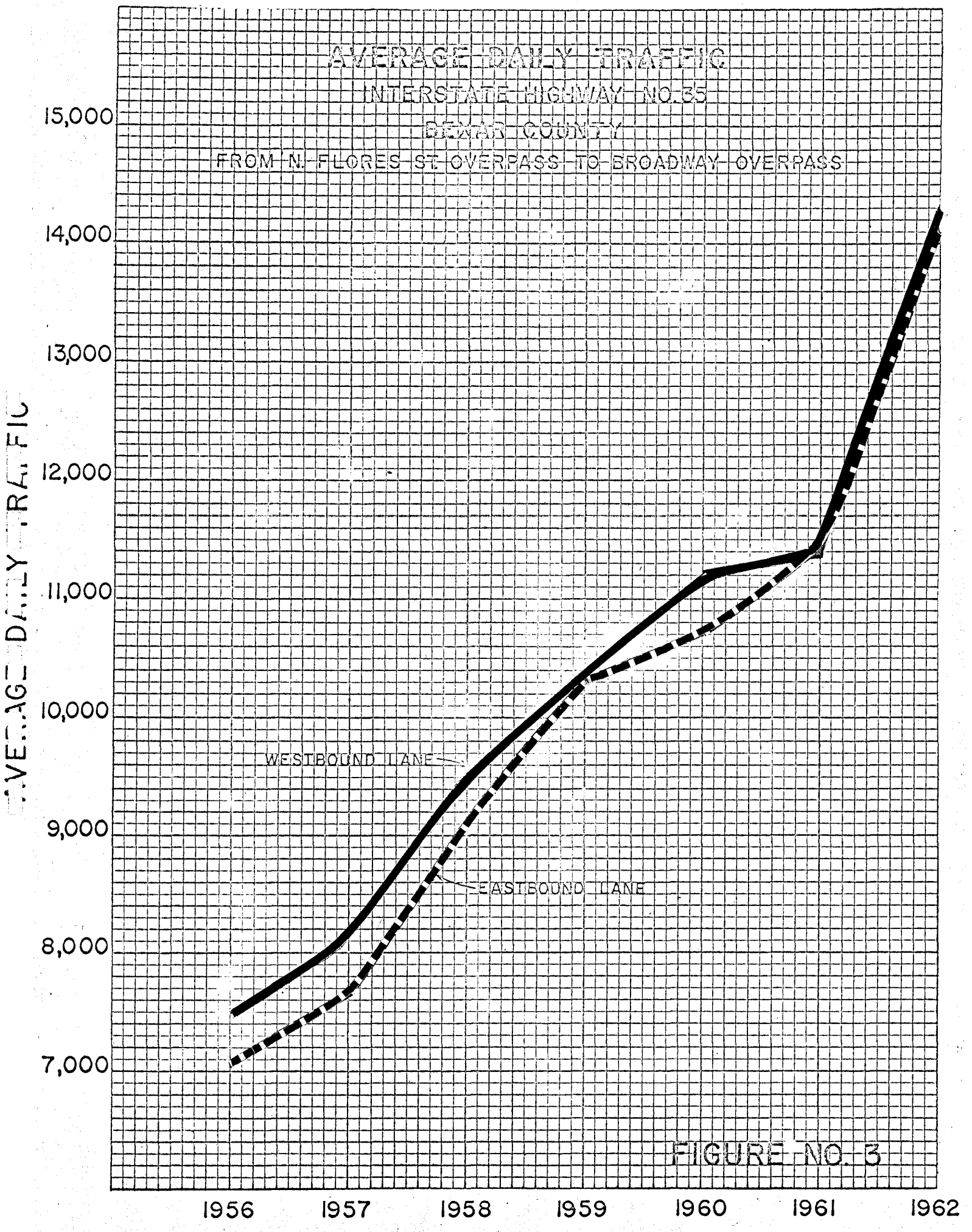
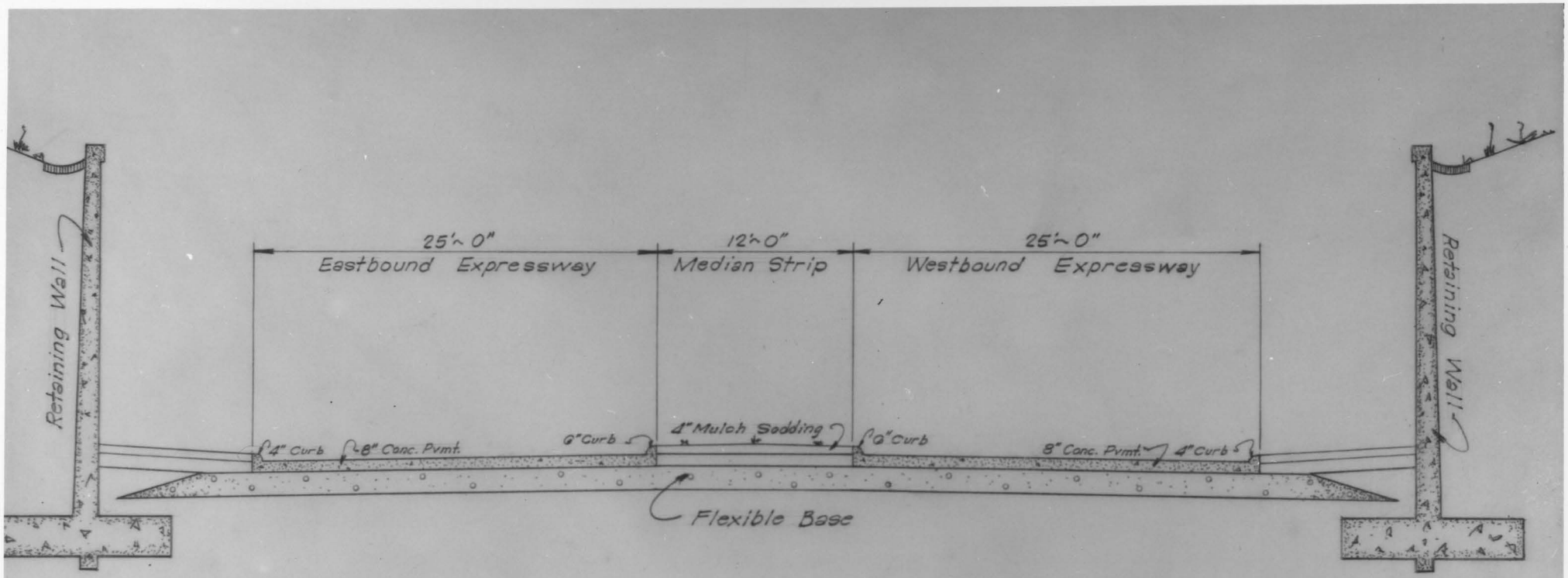

AVERAGE DAILY TRAFFIC
INTERSTATE HIGHWAY NO. 35
BEXAR COUNTY
FROM N. FLORES ST. OVERPASS TO BROADWAY OVERPASS
AVERAGE DAILY TRAFFIC
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
WESTBOUND LANE
EASTBOUND LANE
1956
1957
1958
1959
1960
1961
1962

FIGURE NO. 3



TYPICAL SECTION

INTERSTATE HIGHWAY 35

FROM SOUTH FLORES STREET OVERPASS TO
BEGINNING OF BROADWAY OVERPASS STRUCTURE

CONCRETE PAVEMENT DATA

COMPLETED AND OPENED TO TRAFFIC NOV. 8, 1954
5 SACKS PER CU. YD.
STANDARD BAR REINFORCEMENT
101.5' BETWEEN EXPANSION JOINTS
14.5' SAWED JOINTS
CURING - MEMBRANE CURING COMPOUND
AND PAPER
LIMESTONE AGGREGATES
STANDARD BELT SURFACE FINISH

FIGURE NO. 4

The Typical Section and pertinent concrete pavement design data is shown on Figure 4. The entire section of this highway is generally a depressed section as indicated.

The District was of the opinion that some method of correcting the slick condition of the pavement should be found whereby the identity and color contrast of the original pavement design could be maintained. A request was made to the Research Section of the Austin Office of the Highway Department for assistance in this problem.

IV. POSSIBLE CORRECTIVE MEASURES STUDIED:

A. HYDROCLORIC ACID

It was suggested by the Research Section that acid etching may give the desired rough surface texture. A short test section of the highway was selected and the acid applied. Various solutions of the hydrocloric acid were used from 5% through 50%. A chemical reaction could be observed for about the first minute, after which time no further reaction was noted and the acid washed off the pavement. No benefit of the possible etching effect of the acid could be observed.

B. EPOXY AND POLY-ESTER RESINS

It appears that epoxy or poly-ester resins offer several means of skid proofing concrete pavement and still maintain the original color contrast. From data obtained on the various epoxy and poly-ester resin methods, it seems that the unit cost is rather high. The method of application does not lend itself to the usual maintenance operation, and the period of curing is too long for the heavy

traffic volumes involved.

We believe that the Research Section should study this material and methods of application and keep up with the developments in order to recommend its use as soon as it is within our cost and equipment requirements.

C. SLURRY SEAL

The possibility of a slurry seal was investigated, to some extent, as to a skid proofing material to use on concrete pavement. A sample of medium set cationic emulsion was obtained from an asphalt producer and mixed with silica sand. This sand was used due to its hardness and is the only type aggregate available locally, other than limestone sand. The cationic emulsion was used due to its affinity for the concrete pavement, especially where limestone aggregates are used. Various mixes were made with the percent of emulsion varying from 15% to 22%. This mixture was placed on a small section of concrete pavement in the District yard. See Figure 5 for a picture showing the surface texture of this test section.

It is believed that this product will serve very well as a skid proofing method; however, the behavior of heavy, fast traffic to the seal should be thoroughly investigated before it is put to any general use. It was not considered on the District 15 project, since it did not fulfill the requirements for maintaining the original pavement color.

The slurry seal also has the disadvantage of length of curing time and special equipment needed to apply the material.

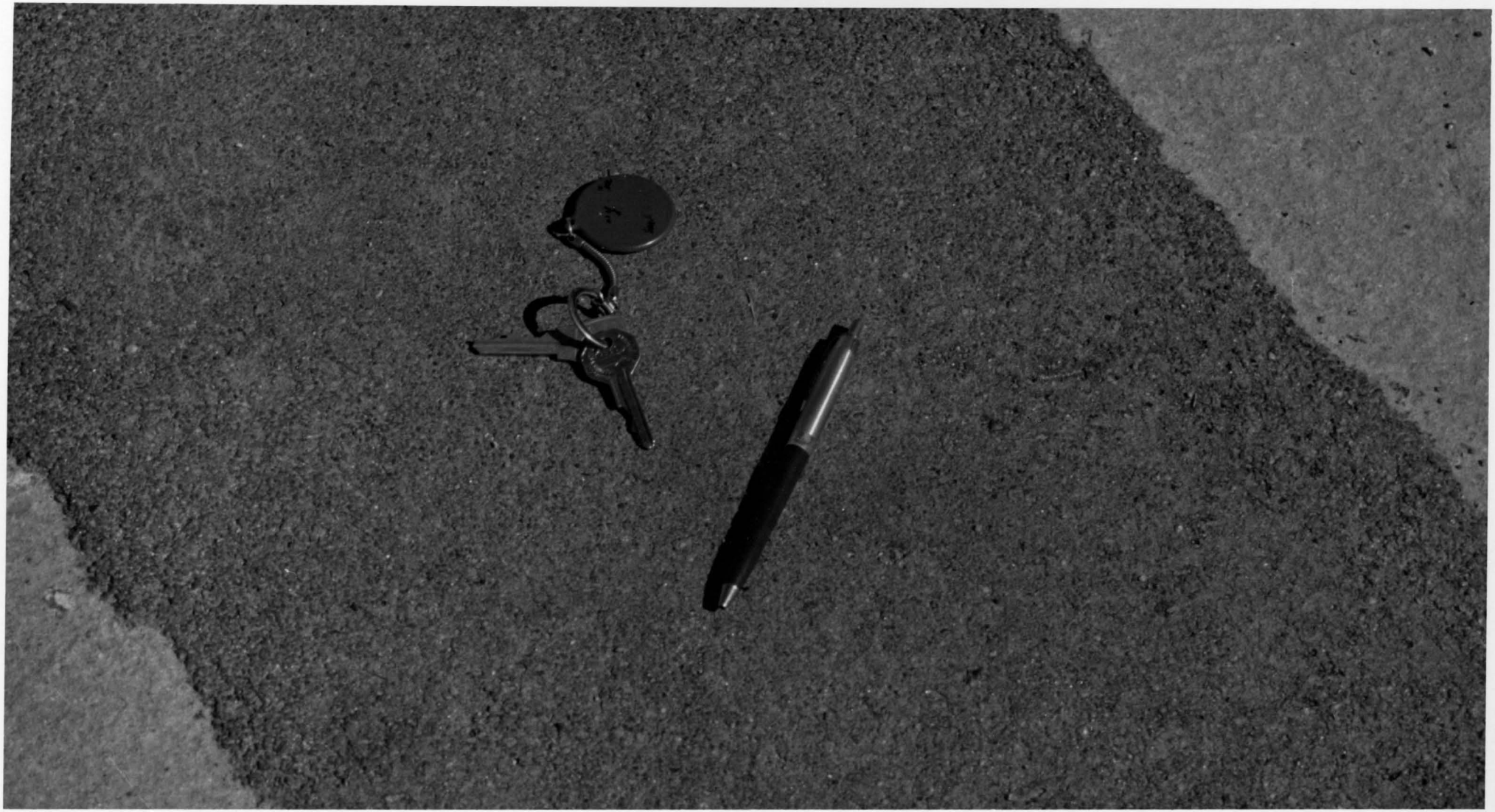


FIGURE NO. 5

D. CONCRETE SAW

From information furnished by the Research Section of the Austin Office, it was decided to use a method of sawing longitudinal grooves in the pavement surface. These grooves to be approximately 1/8" deep and 3/16" between cuts.

Equipment suitable for sawing the pavement was available on a rental basis from the Concut Sales Inc., 1845 Belcroft Ave., El Monte, California at the following rates:

$42.50 per hour for up to 8 hours of a normal working day

$50.00 per hour for all time in excess of 8 hours per normal working day or 40 hours per week

$55.00 per hour for all time worked on Sundays or legal holidays

$25.00 move-in charge (special charge for this project due to fact equipment was working in Texas)

$15.00 per hour for stand-by time during any normal work day not to exceed that necessary to bring the consideration up to that provided for 8 hour work, when this stand-by time is the result of work stoppage directed by the Highway Department

See Figure No. 6 for picture of sawing equipment.

The above rental rates included all equipment maintenance upkeep, operation cost, transportation costs to and from the project, operators, all necessary equipment, workman insurance for the sawing equipment and the operators.

The District Maintenance Forces furnished the necessary water equipment to furnish sufficient water at a pressure of 75 p.s.i. to cool the saw blades. A 4000 gal. water tank was used with 1000 gal.

booster tank to refill the main water source. The required pressure was obtained by the use of a 1½ Hypro water pump with a 4½ H. P. Briggs & Stratton gasoline engine.

The sawing equipment was powered by a 4600-V4 Wisconsin air cooled engine. The original equipment is designed for cutting bumps on concrete pavement, and for this operation uses 120 circular diamond blades. For the grooving operation approximately 42 blades and necessary spacers were used in order to provide the proper spacing between grooves.

V. INTERSTATE HIGHWAY 35 PROJECT DATA:

Work was started on this project on July 10, 1962 and was completed on September 14, 1962 with a total of 58 working days used. The working day was, in general, between the hours of 8:30 A.M. to 4:00 P.M., due to the heavy morning and afternoon peak traffic volume. A total of 344,557 sq. ft. of concrete pavement surface was sawed at a total equipment rental cost of $12,387.50 or a unit cost of $0.034 per sq. ft. In addition to the above, there was a $25.00 move-in charge and a maintenance labor and equipment charge of $2,252.48, which gives a total unit price of $0.0426 per sq. ft.

During the entire sawing operation the highway was open to traffic, with the exception of a short section of the particular lane where sawing operations were in progress. As soon as the equipment was moved off the project at the end of each days work, the entire section was opened to unobstructed traffic movement.

Figure No. 7 shows a picture of the finished pavement surface after completion of the longitudinal sawing.

VI. CONCLUSIONS:

The project, at this time, has not had enough time to evaluate its skid proofing features as applicable to the usual highway traffic. The Research Section of the Highway Design Division has made some tests on the comparable stopping distances between the original surface and the grooved surface under both wet and dry conditions. The results of this test will be found in the report entitled "Field Evaluation of the Saw Cut Method of Skid Proofing Concrete Pavements" by Frank McCullough, Design Engineer, of the Texas Highway Department. The main benefit derived from the pavement sawing, as shown from this report, is the change in the skidding pattern. The matter of side skidding was, for all practical purposes, eliminated and the stopping distance reduced. On multiple lane highways this is a very important feature, since it tends to confine accidents to one lane and reduce severity of any accident.

VII RECOMMENDATIONS

It seems that the type of equipment used on this project could fill a very definite need in the Texas Highway Department. If the Department owned one of these machines and used it on a statewide basis, the Maintenance Division would have the necessary equipment to groove slick concrete pavements. The same equipment could be used to remove irregularities from the riding surface of rough

FIGURE NO. 6

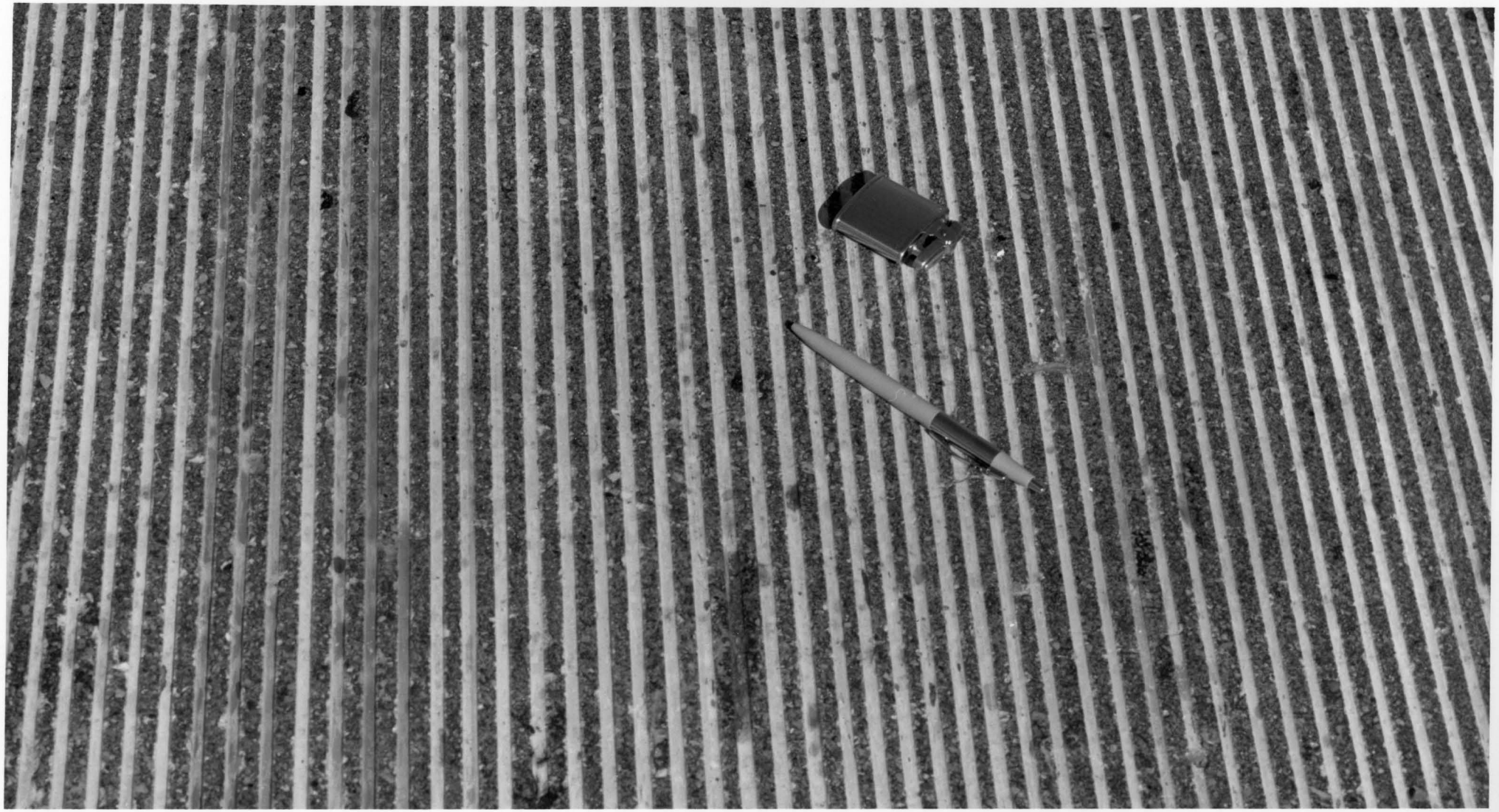


FIGURE NO. 7

concrete pavement. A machine could be built with a wider cutting path and a shorter wheel base that would be more practical for sawing longitudinal grooves than the rented equipment.