

**Longitudinal Grinding  
and Transverse Grooving  
to  
Improve Frictional  
and  
Profile Properties**

Project HR-1035

June 1983

Office of Materials  
Highway Division



**Iowa Department  
of Transportation**

### Disclaimer

The contents of this report reflect the views of the author and do not necessarily reflect the official views or policy of the Iowa Department of Transportation. This report does not constitute a standard, specification or regulation.

LONGITUDINAL GRINDING AND TRANSVERSE GROOVING  
TO  
IMPROVE FRICTIONAL AND PROFILE PROPERTIES

Project HR-1035

June 1983

by

RICHARD D. SMITH

Office of Materials  
Highway Division  
Iowa Department of Transportation  
Ames, Iowa 50010  
Phone 515/239-1392

## TABLE OF CONTENTS

	Page
Introduction - - - - -	1
Texturing - - - - -	2
Friction Testing - - - - -	4
Profiling - - - - -	5
Profilometer Testing - - - - -	5
Cost - - - - -	6
Acknowledgements - - - - -	7
Photographs - - - - -	8

Longitudinal Grinding and Transverse Grooving  
to  
Improve Frictional and Profile Properties

Introduction

There are many miles of portland cement concrete pavement in Iowa that due to normal wear, and in some cases accelerated wear from studded tires, the surface has become polished resulting in less than desirable friction values. Retexturing the surface may be an economical way to re-establish desirable friction values. Retexturing by grinding with diamond blades and transverse grooving with diamond blades are two methods of rehabilitating p.c.c. surfaces.

MU Inc. of Lebanon, Tennessee proposed to provide without charge to the Iowa Department of Transportation, one 1500 ft x 12 ft section each of three methods of texturing. They are longitudinal grinding, transverse grooving and longitudinal grinding followed by transverse grooving. A section of 1500 feet is needed to properly evaluate a texturing method. It was decided by Iowa DOT personnel that due to possible differential friction it would be undesirable to texture only one lane. The decision was made to do test sections of 1500 ft x 24 ft with the cost of the additional texturing paid by the Iowa DOT.

Iowa also has areas where the p.c.c. pavement has faulted at the joints and cracks which results in poor riding quality.

Methods of correcting the faulting are to underseal the pavement where needed and/or grinding the surface to eliminate the faulted areas. It was decided to include in this research project a section for profiling by grinding.

An agreement was made with MU Inc. to do the grinding and grooving. The grooving was done by MU Inc. but the grinding was sublet to Allstate Paving, Inc. of Maple Grove, Minnesota.

#### Texturing

The eastbound lanes of I-80 in the vicinity of milepost 219 in Iowa County were textured by the three methods previously mentioned. The pavement between stations 791+00 and 806+00 was textured by transverse grooving only. The grooving was done with a MU Inc. Full Deck Groover which was developed for grooving the full width of a bridge deck. It has two cutting heads, each two feet long. Diamond impregnated blades are randomly spaced along the cutting heads from 3/4" to 1 1/8" apart, as randomly spaced grooves cause less tire noise than evenly spaced grooves. The grooves on this project are 1/4" deep.

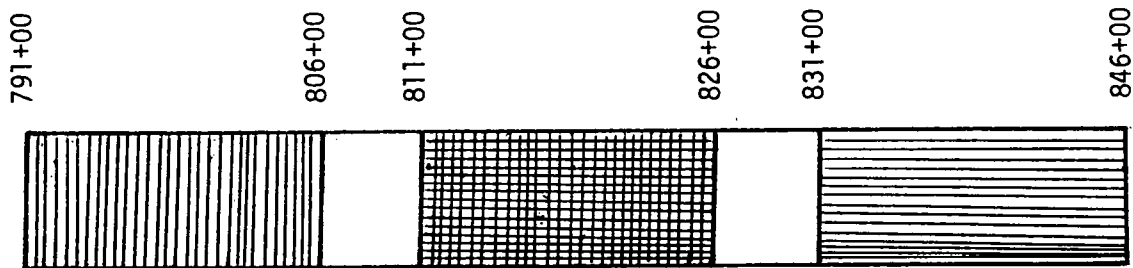
The machine began cutting at the centerline and moved toward the edge of the pavement. When the forward wheels reached the edge, the forward movement would stop and the cutting heads would continue on rails to the edge. All four wheels are steerable so that the machine can be moved in any direction when relocating for the next grooving pass.

Water required to cool the blades is furnished by a tanker truck. The used water, along with the cuttings, is picked up by vacuum and pumped to the road ditch leaving a damp surface. The waste slurry can be pumped into another tanker if necessary.

The pavement between stations 811+00 and 826+00 was textured by longitudinal grinding and then grooved with the MU Full Deck Groover. The longitudinal grinding was done with a Target Model PRM-3800 Safe-T-Planer. This machine is manufactured by Target Products Division of Federal-Mogul Corp.

The machine has a 38" cutting head equipped with 187-14" diameter diamond impregnated blades. This machine also requires water to cool the blades. The water is pumped from a semi-trailer tanker and the waste water and cuttings are picked up by vacuum and pumped to the ditch or another tank truck if necessary. Four passes of the machine were required to texture each lane. The first pass in each lane was along centerline. The texture was 1/16" deep as measured with a tire tread-depth gauge and the grooves 1/4" deep.

Only longitudinal grinding was done between stations 831+00 and 846+00. This was done by the same Target Safe-T-Planer as the previous section. The texturing in this section was also 1/16" deep.



I-80 Eastbound - Iowa County

Test Section Layout

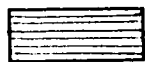
Legend



Transverse grooving



Longitudinal grinding and transverse grooving



Longitudinal grinding

### Friction Testing

The experimental sections were tested with the Iowa DOT friction test trailer (ASTM E274) about one week before and about one week after texturing. The sections were tested with a ribbed tire (ASTM E501) and a smooth tire (ASTM E524). The values in Table I are the average of three tests at 40 m.p.h.

TABLE I

	<u>Driving Lane</u>		<u>Passing Lane</u>	
	Ribbed Tire	Smooth Tire	Ribbed tire	Smooth Tire
	<u>TRANSVERSE GROOVING</u>			
Before	23	11	45	23
After	30	26	51	45
	<u>TRANSVERSE GROOVING PLUS LONGITUDINAL GRINDING</u>			
Before	23	11	48	22
After	46	43	52	47
	<u>LONGITUDINAL GRINDING</u>			
Before	23	11	47	20
After	44	41	52	44

During friction testing, grooves were cut into ribs of the ribbed tire and the smooth tire was grooved full width by the textured surface.



### Profiling

Interstate 80 in Scott County is portland cement concrete pavement with 76 ft between doweled joints. The pavement usually has two cracks between joints which have faulted as much as 3/4".

The pavement was undersealed in 1982 with a fly ash-cement-water slurry. The slabs could not be lifted enough to significantly reduce the faults at the cracks.

The westbound lanes of I-80 between stations 732+00 and 747+00 just west of the IA. 130 interchange were profiled April 5-7, 1983 by Allstate Paving Inc. The same Target Safe-T-Planer used in Iowa County for texturing was used for profiling. Grinding was done in the direction opposing traffic.

Random depth measurements were made with a tire-tread depth gauge. Concrete was being ground as much as 23/32" deep on the high side of a fault.

### Profilometer Testing

The 25 Foot California Profilometer was used to evaluate the profiling. A profilograph was obtained by District 6 Materials personnel before and after grinding. For evaluation, the profilograph is divided into 0.1 mile sections. Profilometer results are given for the corresponding sections in Table II.

TABLE II  
 PROFILE INDEX  
 (inches/mile)

<u>Length</u>	<u>Before</u>	<u>After</u>
Driving Lane		
0.1	39.5	4.5
0.1	36.0	2.0
0.085	<u>30.5</u>	<u>2.3</u>
Average	35.6	3.0
Passing Lane		
0.1	22.0	0.5
0.1	27.5	0
0.085	<u>33.2</u>	<u>2.3</u>
Average	27.2	0.9

The longitudinal grinding was very effective in eliminating faults and improving the profile index.

#### Cost

The price of grinding or grooving the passing lane in Iowa County was \$1.80 per square yard and the combination grinding-grooving was \$3.60 per square yard. The price for profile grinding in Scott County was \$2.10 per square yard for the 1500 ft by 24 ft section.

### Acknowledgements

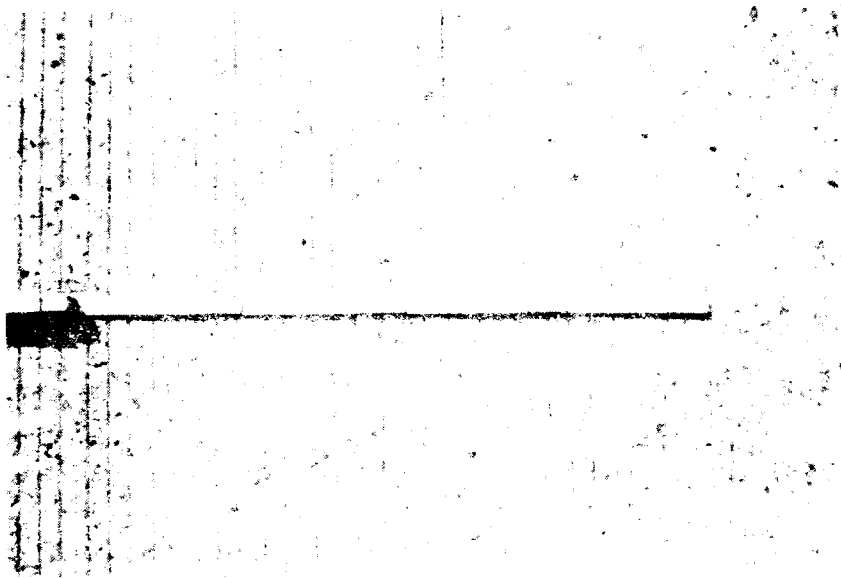
The maintenance personnel from the Williamsburg and Davenport garages furnished traffic control during grinding and grooving. Their willingness to start early and stay late was very much appreciated.

Friction testing was done by Special Investigations personnel of the Office of Materials and the profilometer testing by District 6 Materials personnel.

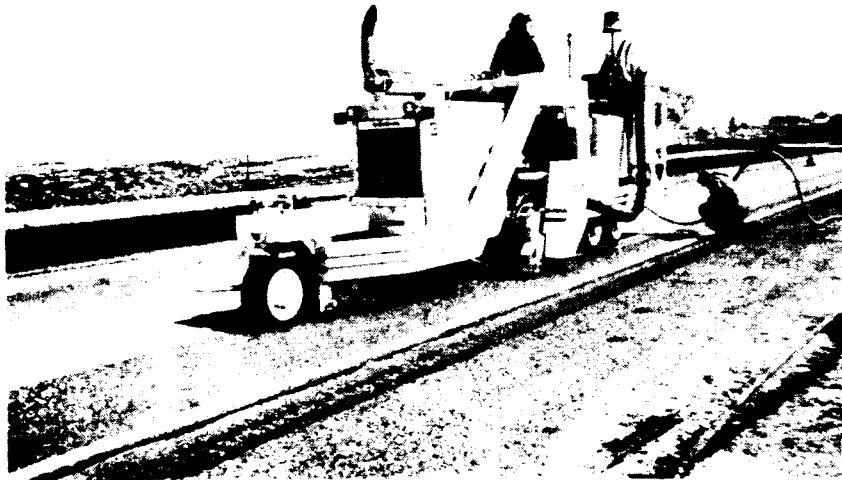
Appreciation is extended to MU Inc. for their contribution and cooperation. The cooperation of Allstate Paving Inc. is also appreciated.



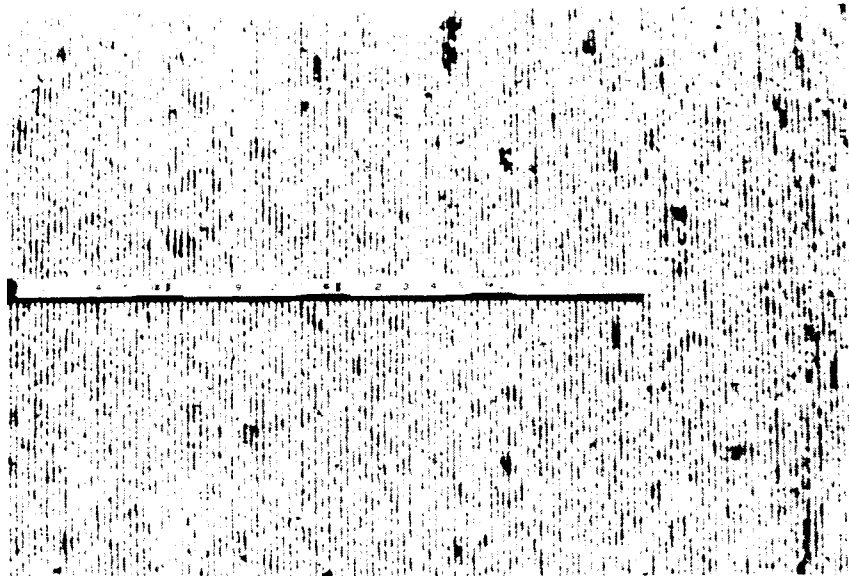
MU Full Day Growth



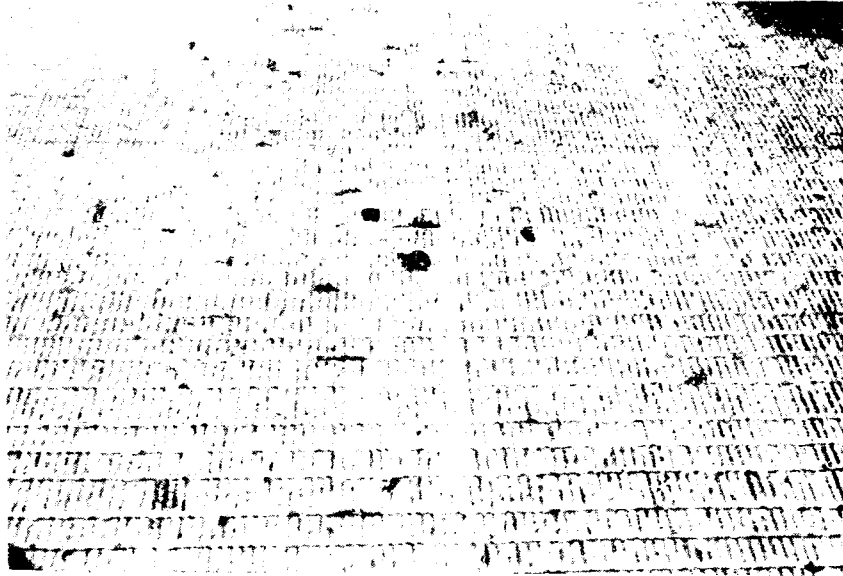
Texture by growing



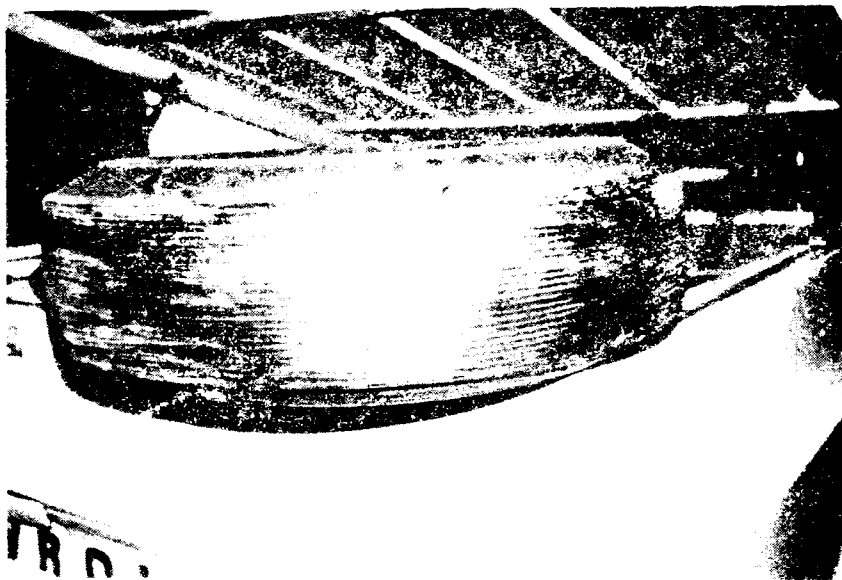
TARGET Safe-T-Planer



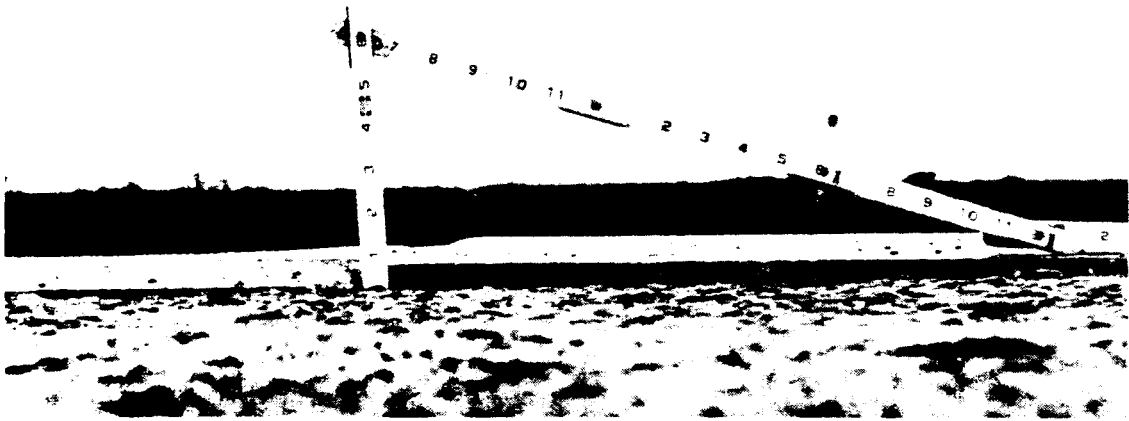
Texture by grinding



Texture by grinding and grooving



Smooth test tire (ASTM 524) after testing



Correction of faulted crack by grinding