

PROFILOMETER MEASUREMENT OF BRIDGE ROUGHNESS

**Research Laboratory Division
Office of Testing and Research
Research Project R-61 F-65
Research Report No. R-421**

**LAST COPY
DO NOT REMOVE FROM LIBRARY**

**Michigan State Highway Department
John C. Mackie, Commissioner
Lansing, May 1963**

PROFILOMETER MEASUREMENT OF BRIDGE ROUGHNESS

Synopsis

A 20-ft rolling straight edge, equipped for semi-automatic recording of roughness of bridge decks and approaches, has been developed by the Research Laboratory Division. Using this profilometer, two test runs are made in each wheel track of each lane of each bridge tested, and on its approaches. Repeatability of the tests is excellent in roughness surveys to date.

Trace analysis by statistical methods for projects studied so far indicates that longitudinally machine-finished spans are smoother than either hand-finished or transversely machine-finished spans. Concrete approach pavements are significantly smoother than bituminous ones, but both types of approach pavement are smoother than hand-finished or transversely machine-finished concrete deck pavement.

A roughness classification system has been developed and monthly reports will be issued in the future, giving data on the structures measured.

For many years the Research Laboratory Division has been interested in the measurement of bridge deck roughness. Early measurement attempts were made with the Michigan Roughometer, but it became obvious that the resolution of this type of instrument was insufficient for accurate description of a structural surface as short in length as a bridge.

In an attempt to improve the quality of the measurements obtained, a standard 10-ft rolling straight-edge, of the type issued to project engineers, was obtained from the Road Construction Division. This instrument was modified so that semi-automatic recording of various displacement increments was possible. Two reports resulted from the work with this device, one covering six highway bridges (1) and the other several railroad crossings (2).

With the advent of machine finishing in Michigan in 1960, the need increased for a faster, more definitive method of evaluating bridge surfaces. In the Spring of 1961, at the request of the Bridge Construction Division, W. W. McLaughlin, Testing and Research Engineer, assigned the Research Laboratory Division the responsibility of checking roughness on all machine finished bridges in the State. As a consequence of this assignment, the Laboratory undertook the design and construction of an instrument which would meet more exacting requirements.

Profilometer Design and Operation

The unit as finally completed (Fig. 1), consists of a three-section truss fabricated of 3 by 3 by 1/4-in. alloy 6061-T6 aluminum angle, supported at each end by a four-wheeled carrying frame. The measuring wheel (Fig. 2) hinged beneath the truss and located at its center, was fabricated of steel covered with a rubber tire machined to an exact 24-in. circumference (7.65 in. OD). The movement of this wheel describes the deviations, in the surface under test, from the plane established by the carrying wheels.

The movement of the measuring wheel is transmitted to the Laboratory-built recorder (Fig. 2) by a steel tape, which in turn causes a hot stylus to move across heat-sensitive recording paper, thereby making a permanent record. The vertical component of the record thus obtained is to actual scale, i. e., 1 in. of vertical wheel movement causes 1 in. of stylus deflection. The paper drive of the recorder is geared to the measuring wheel, so that 1 in. of trace length equals 5 ft of movement along the bridge deck. A second hot stylus rides along the edge of the trace, automatically making an event mark for each foot of travel; it is also used as a manually-actuated marker for recording locations of the ends of spans.

In addition to the trace record, an electro-mechanical digitizer (Fig. 2) has been designed, constructed, and installed on the profilometer. This device converts the vertical movement of the pavement follower wheel to discrete increments of vertical motion. Through the use of an electronic flip-flop circuit and a high speed counter, it accumulates these increments into a single digitized total for the given section under test. Power is supplied by a 12-volt automotive battery.

To date, sufficient data have not been taken to establish the degree of correlation between the trace and the digitizer. However, more data are being taken and a workable, accurate system should soon be in use whereby a number giving a measure of the bridge roughness can be read directly from the instrument.

The test procedure now employed by the Field Tests and Surveys Unit consists of making two test runs in each wheel track of each lane of each bridge and its approaches, in the direction of traffic flow. One hundred feet of approach is run on either side of a bridge if the approaches are of concrete, and 50 ft either side if they are bituminous.



-3-

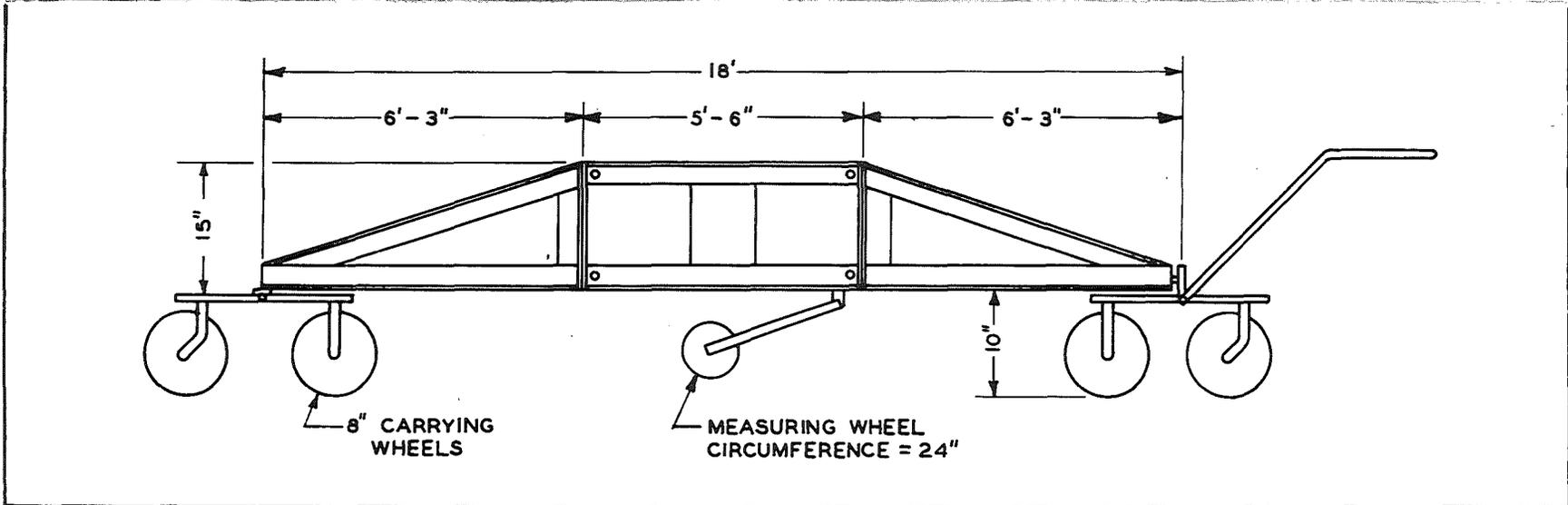


Figure 1. Michigan Bridge Profilometer.

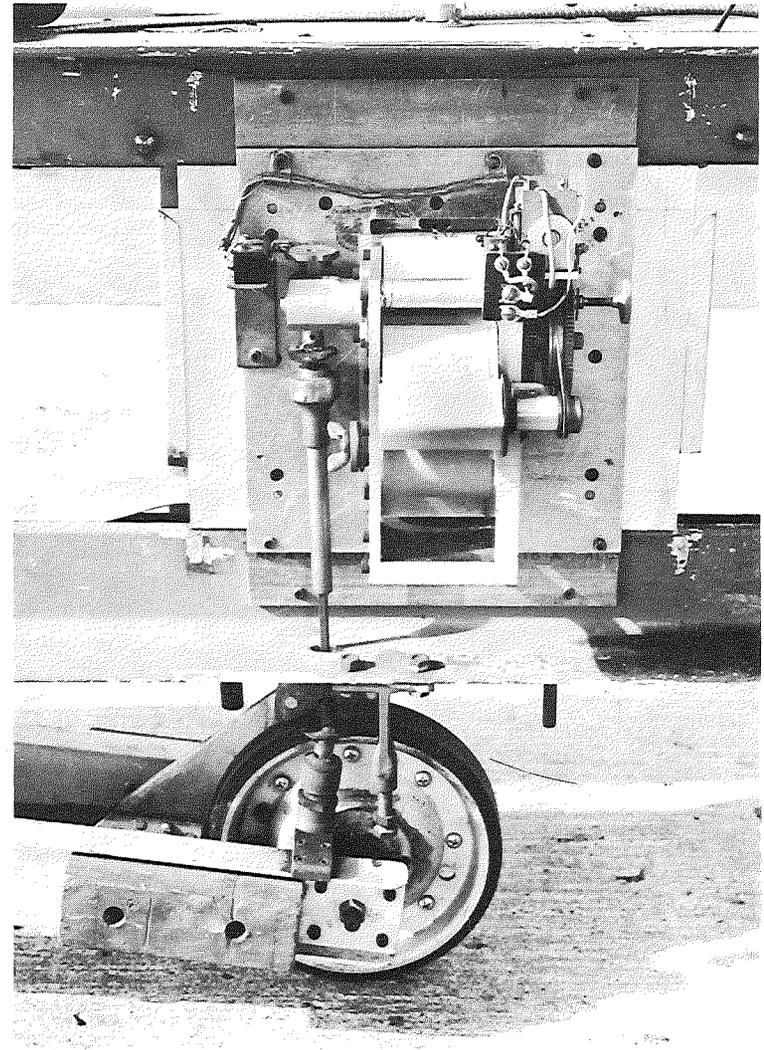
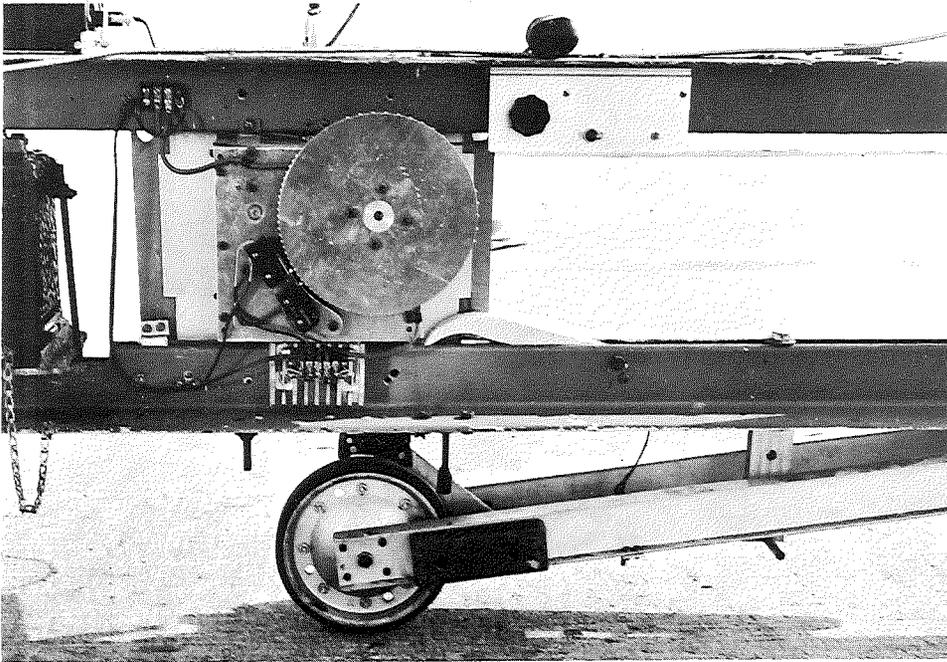
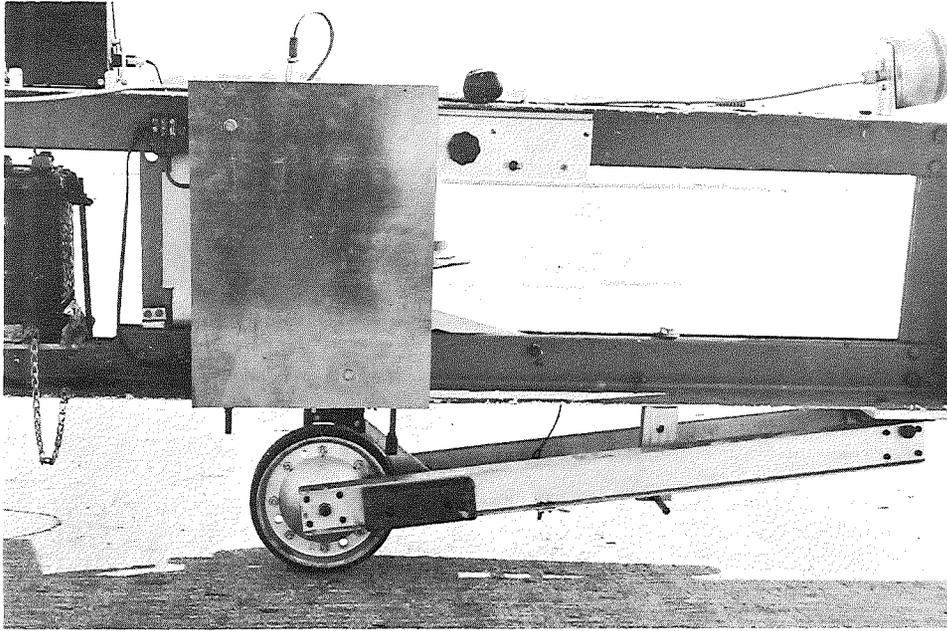


Figure 2. Measuring wheel (upper left), recorder (right), and electro-mechanical digitizer (lower left).

Experience so far indicates excellent repeatability of measurements with this instrument, in that the two runs made in any given wheel track nearly always agree to within 5 percent or less. A plot of frequency distribution for a same-day run-rerun is shown in Fig. 3.

Data Analysis Procedure

Traces from the profilometer are analyzed by the Statistical Analysis and Data Reduction Unit of the Research Laboratory. Separate analyses are made for each approach and each span of each structure. Traces are coded to indicate beginning and ending points of each span, and successive highs and lows within the span differing from an immediately preceding figure by at least 2 mm. The arbitrary 2-mm interval which was chosen to eliminate very fine variations in surface texture from the analysis, considerably increases analysis repeatability, and decreases the analysis time. Traces are then placed on the Benson-Lehner oscillograph strip chart amplitude reader to transform the data from analog to tabular digital form. After the data have been tabulated and reduced, frequency distributions of roughness values are made, based on categories of 20 in. per mile. Plots of these distributions on normal probability paper are then made, to ascertain the degree of normality of the distributions. If the distributions look reasonably normal, a normal curve is fitted to each distribution to permit comparison with the other distributions. Statistical significance tests are then applied.

Curves of frequency of occurrence vs. roughness are shown in Fig. 4. The roughness figure is a sum of the absolute values of the differences between successive amplitude peaks and valleys, converted to inches per mile. Visual inspection indicates, and statistical tests confirm, that the longitudinally machine-finished spans are significantly smoother than either hand-finished or transversely machine-finished bridges, and also less rough than concrete or bituminous approaches. Roughness does not differ significantly between hand-finished and transversely machine-finished bridges. Concrete approaches are significantly better than bituminous approaches and both types of approaches are superior to hand-finished or transversely machine-finished bridge pavements.

A tentative roughness classification for bridges has been established, placing roughly one-fourth of the spans in the "good," half in the "average," and another fourth in the "poor" category. Roughness figures of less than 100 in. per mi are considered good, 100 to 160 average, and above 160 poor. This classification is for the bridge profilometer only, and should not be confused with somewhat similar terms and categories for the MSHD Roughometer Integrator, which is primarily for pavements.

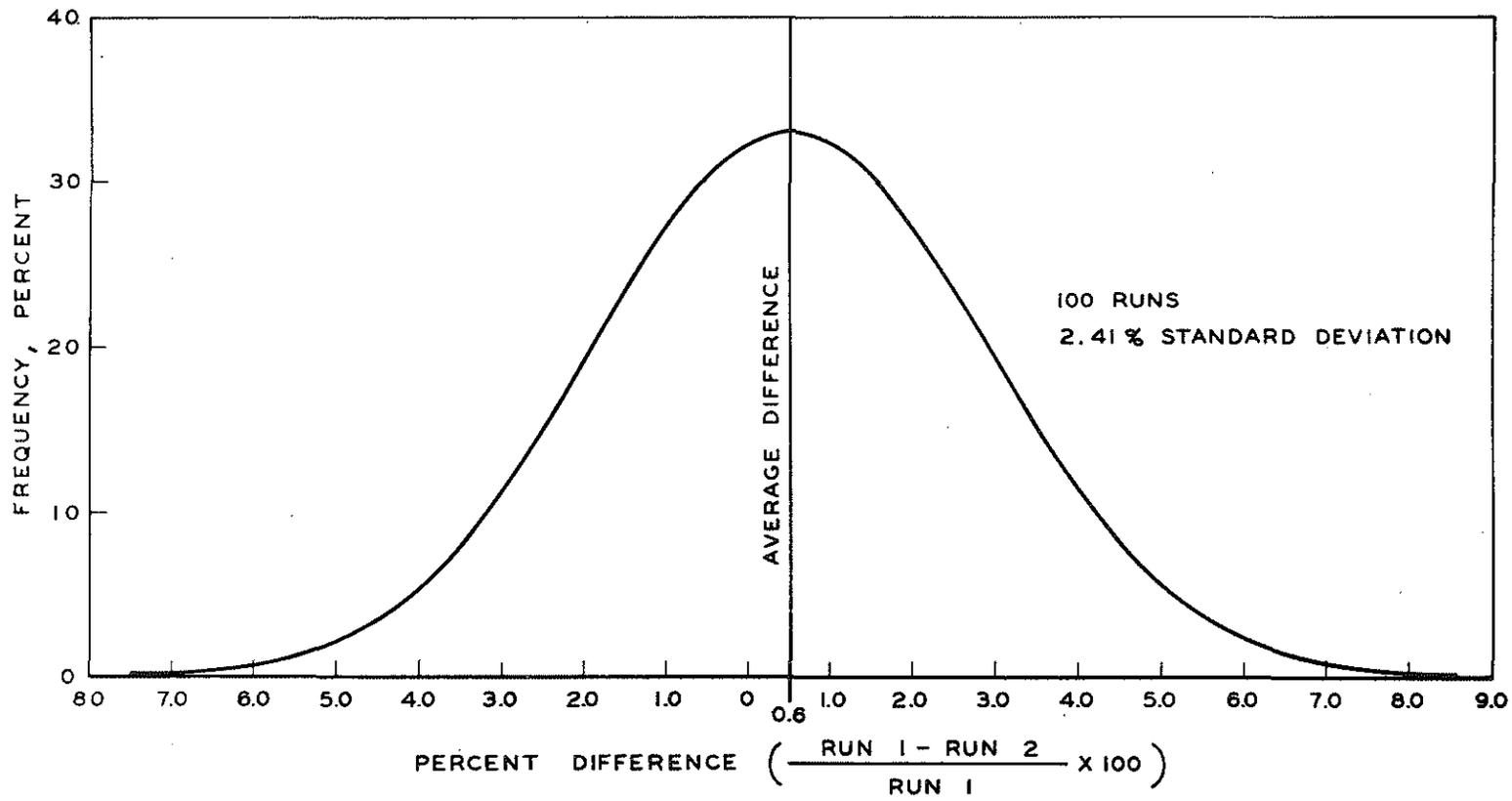
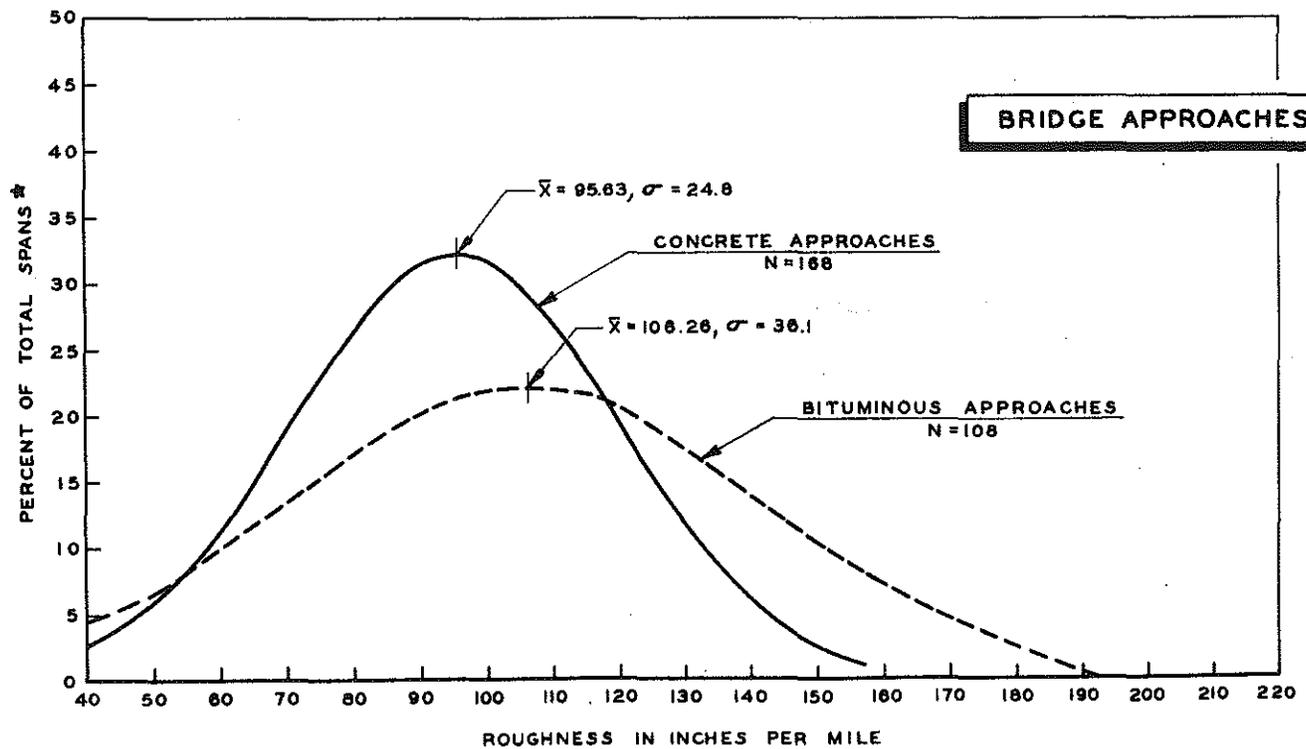
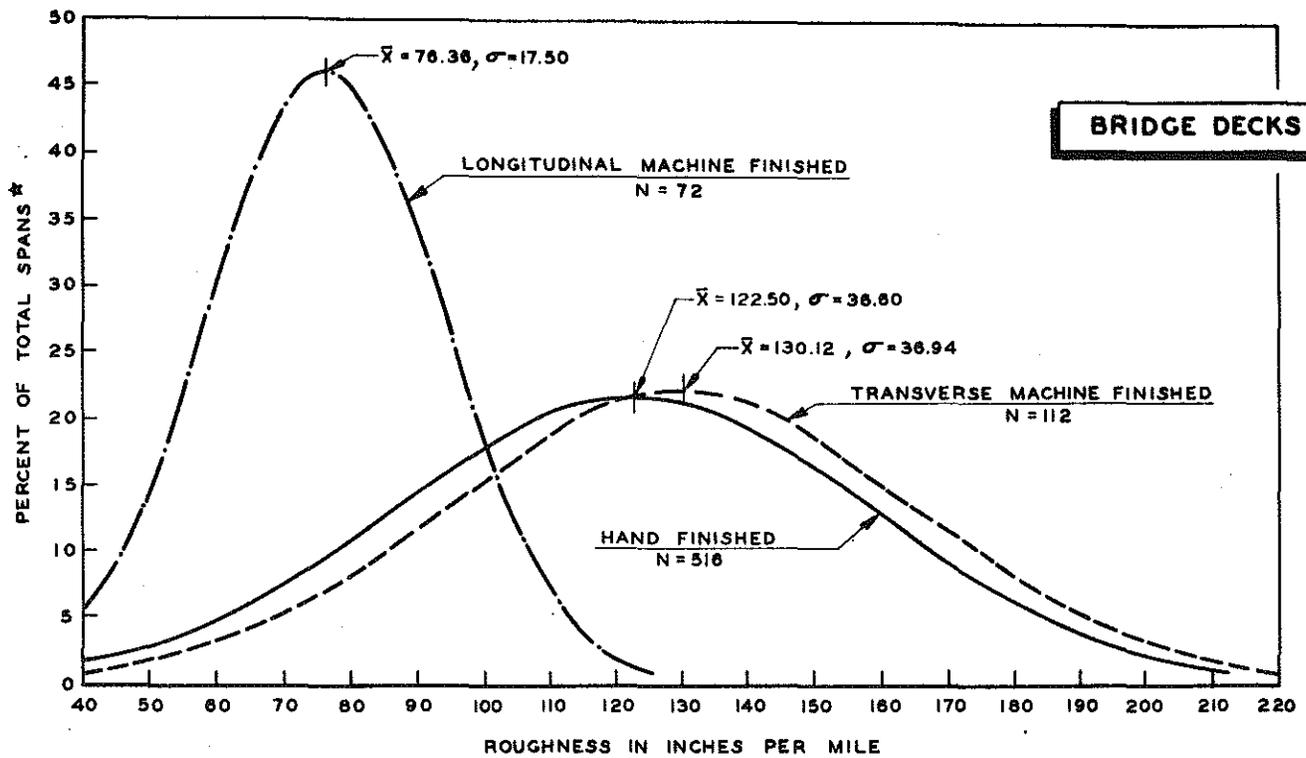


Figure 3. Instrument repeatability distribution for class intervals of 2 percent for a same-day run-screen. Data based on 2-mm minimum roughness criterion.



* BASED ON 20-IN. PER MI CLASS INTERVAL
 N=NUMBER OF RUNS
 \bar{x} =AVG ROUGHNESS, IN. PER MI
 σ =STD DEVIATION

Figure 4. Roughness in relation to method of deck finishing and approach pavement type.

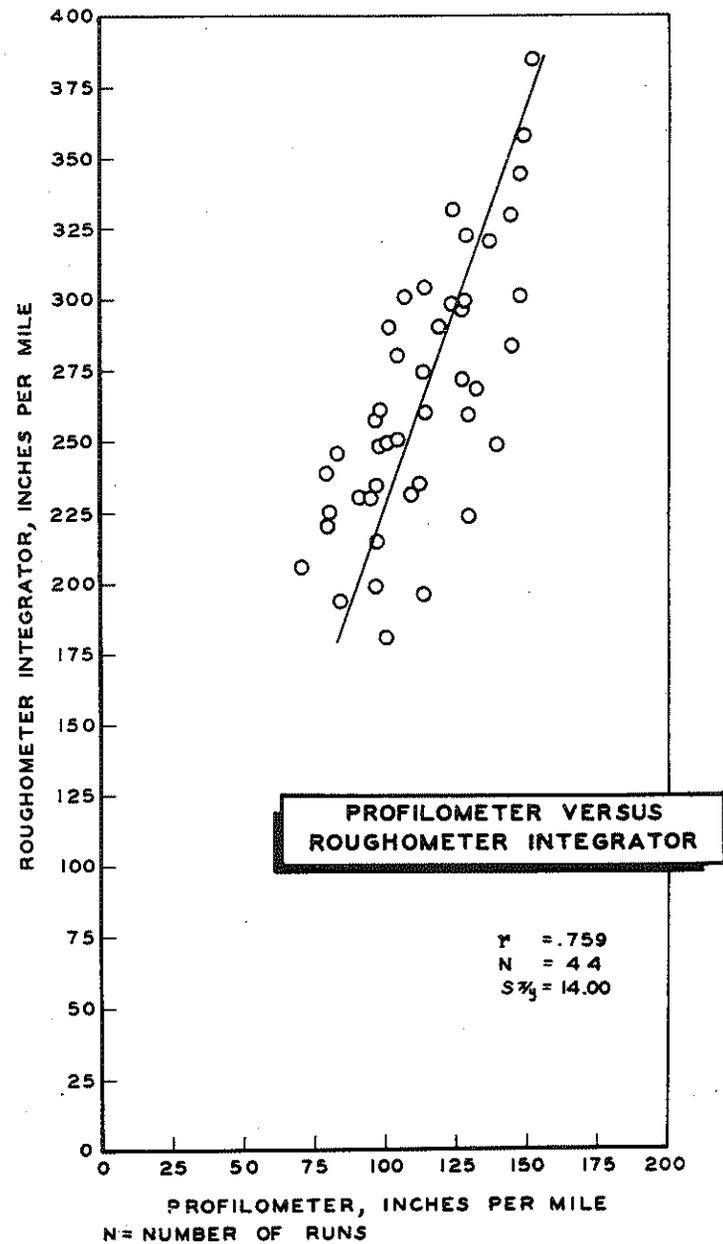
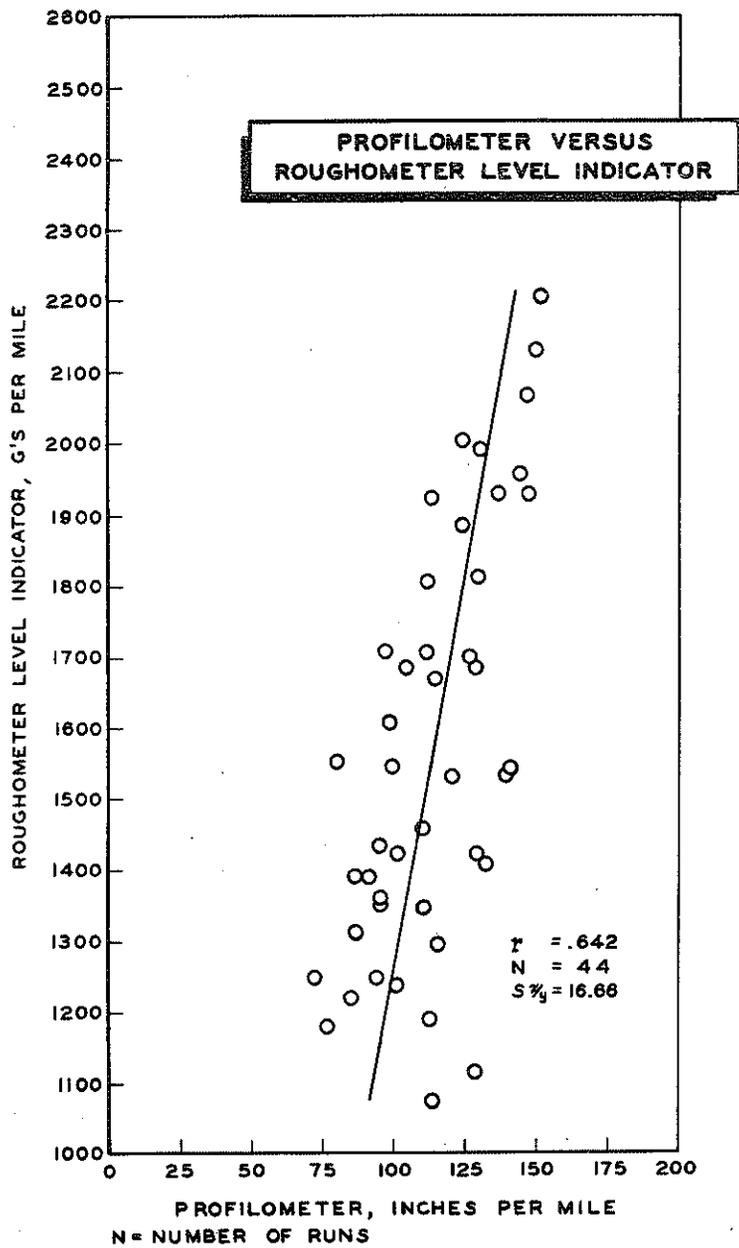


Figure 5. Corresponding roughness values for Profilometer vs. Roughometer Level Indicator and Integrator.

Several structures have been run with the MSHD pavement Roughometer as well as the profilometer for comparison purposes. The results of the tests are plotted in Fig. 5. Correlation is not good for these initial tests and more data are now being taken, with more complete results to be included in a subsequent report. For the bridges tested in this correlation study, the roughometer integrator shows no values below 175 in. per mi (Fig. 5), which would place all these bridges in the roughometer classification of "poor pavement."

Data sheets included in the appendix show information for individual structures. This study is continuing, and at present, requests for measurement of 138 structures have been received. In general, future monthly reports will be transmitted with little or no discussion, and will present the data for each structure in a manner similar to the sheets shown in the appendix.

References

1. Hooper, R. E. and Oehler, L. T. "Roughness Measurements of Bridge Decks and Approaches." Michigan State Highway Department Research Report No. 325 (March 1960).
2. Hooper, R. E. "Roughness Evaluation of Railroad Crossings in Battle Creek." Michigan State Highway Department Research Report No. 337 (July 1960).

APPENDIX

DATA SHEETS FOR MEASURED STRUCTURES
(Arranged by District, in numerical order by structure)

District 2
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number X01 of 17033, Location I 75 over Tone Road and R. R.

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 4 Machine Finished Yes No

N Bound Roadway

Date Measured 10-11-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach						
Span 1	51.0	57.4	59.5	53.4	94.7	66.3
2	71.5	96.0	111.2	109.3	114.1	107.8
3	72.6	101.4	98.6	85.8	111.6	99.6
4	52.5	54.3	61.8	83.0	81.0	70.4
5						
6						
<u>N</u> Approach						
Average	247.6	80.8	86.4	85.3	102.4	88.7

S Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach						
Span 1	51.0	102.5	62.6	79.7	104.6	87.0
2	71.5	150.7	92.7	142.6	167.6	138.1
3	72.6	120.4	130.6	133.4	112.8	124.4
4	52.5	140.3	123.2	115.2	132.2	127.7
5						
6						
<u>N</u> Approach						
Average	247.6	129.6	104.0	121.1	131.0	121.3

Remarks All joints numbered from south to north. Joint #1 - Construction; #2 - Expansion #3 - Steel Expansion; #4 - Expansion; #5 - Construction.

District 2
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S03 of 17033, Location Air Force Road over I 75
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

E Bound Roadway

Date Measured 10-11-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	104.0	126.2			115.1
Span 1	36.6	109.6	189.0			150.0
2	70.3	73.2	86.8			79.6
3	71.1	119.2	125.2			121.8
4	36.5	157.0	104.8			130.2
5						
6						
<u>E</u> Approach	50.0	127.8	121.4			124.6
Average	314.5	111.2	121.2			116.2

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	120.4	89.8			105.6
Span 1	36.6	103.9	101.7			102.4
2	70.3	115.0	116.4			115.7
3	71.1	106.2	104.7			105.4
4	36.5	171.4	133.0			151.9
5						
6						
<u>E</u> Approach	50.0	122.0	125.6			123.6
Average	314.5	120.2	111.2			115.7

Remarks Joints and spans numbered from west to east. Joint #1 - Construction; #2 - Expansion; #3 - Steel Expansion; #4 - Expansion; #5 - Construction.

Bituminous approaches.

District 2
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S03 of 17034, Location 3 Mile Road over I 75
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

E Bound Roadway

Date Measured 10-9-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	103.0	107.2			105.6
Span 1	36.5	128.8	142.5			136.0
2	76.5	122.2	120.4			121.5
3	75.5	121.7	101.8			111.9
4	36.5	146.1	112.1			128.8
5						
6						
<u>E</u> Approach	50.0	122.5	121.4			122.5
Average	325.0	122.6	115.8			119.3

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	129.9	106.7			118.3
Span 1	36.5	208.3	182.3			195.3
2	76.5	210.2	183.2			196.7
3	75.5	111.5	168.2			139.9
4	36.5	115.7	138.2			127.3
5						
6						
<u>E</u> Approach	50.0	127.8	99.8			114.0
Average	325.5	151.4	150.0			150.8

Remarks All joints and spans numbered from west to east. Joint #1 - Construction; #2 - Expansion; #3 - Metal Expansion; #4 - Expansion; #5 - Construction.

Bituminous approaches.

District 2
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S04 of 17034, Location Easterday Avenue over I 75
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

E Bound Roadway

Date Measured 10-9-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	100.0	107.5	130.5			119.0
Span 1	43.4	135.1	158.2			146.6
2	70.9	154.2	101.3			127.7
3	56.5	142.1	123.4			132.7
4	57.5	148.3	133.6			141.4
5						
6						
<u>E</u> Approach	100.0	101.7	69.2			85.4
Average	428.3	126.7	113.6			120.2

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	100.0	91.3	102.5			96.9
Span 1	43.4	188.6	196.5			192.6
2	70.9	127.0	100.2			113.6
3	56.5	136.4	150.9			143.7
4	57.5	151.5	132.7			142.1
5						
6						
<u>E</u> Approach	100.0	83.4	62.1			72.7
Average	428.3	119.3	112.3			115.8

Remarks Joints and spans numbered from west to east. Joint #1 and #2 - Expansion;
#3 - Construction; #4 - Expansion; #5 - Steel Expansion; #6 - Expansion; #7 - Construction;
#8 - Expansion.

District 2
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number B06 of 49025, Location I 75 over Pine River
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 9 Machine Finished (Special) Yes No

N Bound Roadway

Date Measured 10-10-62

Item Span No.	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
1	58.0	54.6	40.5	29.5	63.3	47.3
2	58.0	102.4	72.8	105.6	101.5	95.6
3	58.0	87.8	75.6	51.4	77.8	72.8
4	58.0	92.8	58.2	84.6	76.4	78.3
5	58.0	84.7	71.9	87.4	71.4	79.2
6	58.0	96.0	86.9	88.7	81.9	88.3
7	58.0	94.6	74.1	65.5	71.0	76.5
8	58.0	89.2	98.7	61.9	56.8	76.5
9	58.0	56.0	75.5	58.2	51.0	60.1
Average		84.2	72.7	70.3	72.3	74.9

S Bound Roadway

Item Span No.	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
1	58.0	82.4	41.0	48.2	62.3	58.2
2	58.0	75.6	81.9	83.2	65.5	76.5
3	58.0	86.5	84.1	77.0	51.0	74.6
4	58.0	79.6	73.7	87.3	94.2	83.7
5	58.0	82.9	79.2	76.5	60.1	71.9
6	58.0	93.7	101.5	71.4	55.0	80.1
7	58.0	104.2	99.7	74.6	104.2	95.6
8	58.0	108.8	93.8	74.2	62.8	84.6
9	58.0	69.6	99.2	63.2	53.7	71.0
Average		85.8	83.8	72.6	67.6	77.4

Average
Remarks

Spans and joints are measured from south to north.

All joints are expansion joints at piers.

Note that no filler or seal is in joint and wood spacer is still in place.

District 2
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number B06 of 49025, Location I 75 over Pine River
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 9 Machine Finished (Special) Yes No

N Bound Roadway

Date Measured 10-10-62

Item Span No.	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
1	58.0	54.6	40.5	29.5	63.3	47.3
2	58.0	102.4	72.8	105.6	101.5	95.6
3	58.0	87.8	75.6	51.4	77.8	72.8
4	58.0	92.8	58.2	84.6	76.4	78.3
5	58.0	84.7	71.9	87.4	71.4	79.2
6	58.0	96.0	86.9	88.7	81.9	88.3
7	58.0	94.6	74.1	65.5	71.0	76.5
8	58.0	89.2	98.7	61.9	56.8	76.5
9	58.0	56.0	75.5	58.2	51.0	60.1
Average		84.2	72.7	70.3	72.3	74.9

S Bound Roadway

Item Span No.	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
1	58.0	82.4	41.0	48.2	62.3	58.2
2	58.0	75.6	81.9	83.2	65.5	76.5
3	58.0	86.5	84.1	77.0	51.0	74.6
4	58.0	79.6	73.7	87.3	94.2	83.7
5	58.0	82.9	79.2	76.5	60.1	71.9
6	58.0	93.7	101.5	71.4	55.0	80.1
7	58.0	104.2	99.7	74.6	104.2	95.6
8	58.0	108.8	93.8	74.2	62.8	84.6
9	58.0	69.6	99.2	63.2	53.7	71.0
Average		85.8	83.8	72.6	67.6	77.4

Remarks

Spans and joints are measured from south to north.

All joints are expansion joints at piers.

Note that no filler or seal is in joint and wood spacer is still in place.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Bridge Number S01 of 09111, Location Wilder Road over I 75 Form 511
Dual Structures (separate for each roadway) Yes No
Single Structure Yes No
Number of Spans 4 Machine Finished Yes No

E Bound Roadway

Date Measured 8-14-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	118.8	120.4			119.3
Span 1	44.8	156.8	174.4			165.0
2	60.6	189.0	136.4			162.9
3	60.3	131.4	105.3			117.9
4	45.1	181.5	153.4			167.4
5						
6						
<u>E</u> Approach	50.0	142.0	91.4			116.2
Average	311.4	153.2	128.4			140.8

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	126.8	100.8			114.0
Span 1	44.8	110.2	128.5			119.0
2	60.6	128.6	107.6			118.5
3	60.9	172.6	157.8			164.7
4	45.1	140.5	151.6			146.3
5						
6						
<u>E</u> Approach	50.1	105.6	84.5			95.0
Average	311.4	132.3	122.0			127.2

Remarks Joints and spans numbered from west to east. Joint #1 - Construction; #2 - Plane of Weakness; #3 - Steel Expansion; #4 - Expansion #5 - Steel Expansion; #6 - Plane of Weakness; #7 - Construction.

Bituminous approaches.

Some tar scattered on bridge.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S02 of 09035, Location N. Union Road over I 75
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

E Bound Roadway

Date Measured 8-14-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach						
Span 1	41.2	76.2	81.4			79.5
2	62.0	127.8	109.4			118.4
3	70.5	113.8	106.0			110.1
4	32.7	353.6	128.4			240.6
5						
6						
<u>E</u> Approach						
Average	206.4	148.5	105.6			127.1

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach						
Span 1	41.2	130.1	106.4			117.9
2	62.0	161.8	139.3			150.7
3	70.5	146.4	111.2			128.8
4	32.7	138.8	109.8			124.3
5						
6						
<u>E</u> Approach						
Average	206.4	146.6	118.4			132.5

Remarks Joints and spans numbered from west to east. Joint #1 - Construction; #2 - Steel Expansion; #3 - Expansion; #4 - Steel Expansion; #5 - Construction.

Tar and chip approaches.

Some tar and chips on bridge.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S01 of 56044, Location M-18 Crossing US-10
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

N Bound Roadway Date Measured 9/21/62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	100.0	90.8	73.1			81.8
Span 1	44.6	107.2	111.3			108.9
2	81.7	100.2	112.8			106.6
3	70.7	66.5	102.7			84.4
4	44.2	148.1	130.2			138.6
5						
6						
<u>N</u> Approach	100.0	92.6	111.4			101.9
Average	441.2	96.5	103.6			99.9

S Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	100.0	93.8	97.4			95.6
Span 1	44.6	119.6	125.5			123.1
2	81.7	87.0	84.6			86.0
3	70.7	64.6	59.0			62.0
4	44.2	85.4	86.0			86.0
5						
6						
<u>N</u> Approach	100.0	91.8	110.4			101.4
Average	441.2	89.2	93.6			91.3

Remarks Joints and spans numbered from west to east.

Joint #1 and 2 - expansion; #3 - construction; #4 - steel expansion; #5 - expansion;

#6 - steel expansion; #7 - constructon; #8 and 9 - expansion.

Concrete approaches

Third lane on west side not included.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Bridge Number S02 of 56044, Location W. Grand River over U.S. 10 Form 511
Dual Structures (separate for each roadway) Yes No
Single Structure Yes No
Number of Spans 4 Machine Finished Yes No

S Bound Roadway

Date Measured 8-16-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	50.0	78.2	93.4			85.8
Span 1	42.7	161.4	168.8			165.0
2	68.3	121.8	138.4			129.9
3	68.0	100.2	87.8			94.0
4	43.2	113.0	103.3			107.6
5						
6						
<u>N</u> Approach	50.0	68.6	91.9			80.3
Average	322.2	106.3	112.8			109.5

N Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	50.0	82.4	104.0			92.9
Span 1	42.7	179.3	166.3			172.8
2	68.3	146.9	112.1			129.5
3	68.0	95.2	107.2			100.9
4	43.2	110.0	137.4			123.4
5						
6						
<u>N</u> Approach	50.0	81.4	139.9			110.9
Average	322.2	115.2	124.8			119.9

Remarks Joints and spans numbered from south to north. Joint #1 - Construction; #2 - Steel Expansion; #3 - Expansion; #4 - Steel Expansion; #5 - Construction.

Bituminous approaches.

Drops of tar scattered on bridge.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Bridge Number B04 of 56044, Location US-10 Crossing Sanford Lake Form 511

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 3 Machine Finished Yes No

E Bound Roadway Date Measured 9/20/62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>W</u> Approach	100.0	86.6	79.8	106.4	108.3	95.0
Span 1	109.0	139.4	134.8	120.3	138.9	133.6
2	136.3	126.7	129.2	86.6	112.7	113.9
3	109.0	106.4	86.6	110.1	122.4	106.5
4						
5						
6						
<u>E</u> Approach	100.0	127.6	113.2	114.6	127.8	120.9
Average	554.3	118.2	110.2	106.5	121.8	114.3

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>W</u> Approach	100.0	112.0	103.0	108.0	94.2	104.5
Span 1	109.0	109.4	126.9	132.0	120.8	122.1
2	136.3	137.6	163.3	143.4	155.0	149.9
3	109.0	123.0	107.8	105.4	107.6	110.9
4						
5						
6						
<u>E</u> Approach	100.0	111.2	109.3	100.3	124.6	111.4
Average	554.3	119.8	124.6	119.6	122.6	121.6

Remarks Joints numbered from west to east.

Joints #1 and 2 - expansion; #3 - construction; #4 - steel expansion; #5 - expansion;

#6 - construction; #7, 8 and 9 - expansion.

Concrete approaches

(Revised - West Bound Roadway added)

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S02 of 73111, Location King Road over I 75

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 4 Machine Finished Yes No

E Bound Roadway

Date Measured 8-22-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	87.6	84.4			86.6
Span 1	34.6	258.6	214.4			236.5
2	68.4	155.2	91.8			123.5
3	67.4	156.6	123.8			140.2
4	34.3	176.2	225.6			200.1
5						
6						
<u>E</u> Approach	50.0	119.8	67.0			92.9
Average	304.7	152.8	122.6			137.6

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	126.7	112.5			119.3
Span 1	34.6	191.5	186.2			189.2
2	68.4	123.2	151.7			137.4
3	67.4	150.8	143.8			147.3
4	34.3	162.4	186.2			174.0
5						
6						
<u>E</u> Approach	50.0	132.5	64.4			98.2
Average	304.7	143.6	137.0			140.4

Remarks Joints and spans numbered from west to east. Joint #1 - Construction; #2 - Expansion; #3 - Steel Expansion; #4 - Expansion; #5 - Construction.

Bituminous approaches.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S04 of 73111, Location M 46 over I 75
Dual Structures (separate for each roadway) Yes No
Single Structure Yes No
Number of Spans 4 Machine Finished Yes No

E Bound Roadway Date Measured 8-21-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	100.0	84.5	71.0	86.6	83.2	81.3
Span 1	32.5	117.8	155.2	138.9	146.2	138.1
2	74.2	157.3	142.3	142.0	127.4	142.3
3	73.4	93.5	92.1	120.4	113.2	105.0
4	32.5	148.6	121.0	160.0	138.9	143.0
5						
6						
<u>E</u> Approach	100.0	129.4	142.3	126.8	119.8	129.4
Average	412.6	117.8	115.4	122.2	114.8	117.2

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	100.0	94.0	97.7	109.3	94.8	98.7
Span 1	32.5	97.5	104.0	150.3	104.8	113.7
2	74.2	97.5	116.0	99.3	127.4	110.3
3	73.4	124.1	109.7	112.9	144.2	108.6
4	32.5	138.9	159.2	158.4	136.4	147.8
5						
6						
<u>E</u> Approach	100.0	92.9	109.8	116.4	134.6	113.5
Average	412.6	103.6	111.4	117.0	123.2	113.7

Remarks Joints and spans numbered from west to east. Joint #1 and 2 - Expansion; #3 - Construction; #5 - Steel Expansion; #6 - Expansion; #7 - Construction; #8 and 9 - Expansion. Concrete approaches.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S05 of 73111, Location Jones Road over I 75
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

E Bound Roadway

Date Measured 8-21-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach						
Span 1	33.2	178.3	192.0			185.1
2	74.5	182.1	161.6			171.5
3	75.5	144.1	170.6			157.3
4	32.2	147.6	132.0			139.4
5						
6						
<u>E</u> Approach	50.0	154.7	85.5			120.4
Average	265.4	154.6	142.7			148.8

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach						
Span 1	33.2	277.8	204.5			242.3
2	74.5	137.1	131.1			133.9
3	75.5	173.4	165.7			169.2
4	32.2	182.0	127.0			154.1
5						
6						
<u>E</u> Approach	50.0	188.0	125.2			156.3
Average	265.4	169.5	140.7			155.1

Remarks Joints and spans numbered from west to east. Joint #1 - Construction; #2 - Expansion; #3 - Steel Expansion; #4 - Expansion; #5 - Construction. Bituminous approaches.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number B02 of 73171, Location I 75 over Cass River
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

S Bound Roadway

Date Measured 8-23-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	100.0	43.3	48.3	72.1	63.9	57.0
Span 1	69.6	105.8	100.6	86.5	80.0	93.3
2	69.4	132.4	126.7	102.7	134.6	124.0
3	70.6	85.6	93.1	120.0	165.2	115.9
4	69.6	94.4	103.2	85.0	85.0	91.8
5						
6						
<u>N</u> Approach	100.0	52.6	63.4	62.6	66.6	61.2
Average	479.2	80.9	85.0	85.6	95.0	86.6

N Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	100.0	77.6	75.0	84.2	62.8	75.0
Span 1	69.6	107.4	121.4	108.8	102.0	110.0
2	69.4	110.4	113.0	120.2	76.4	105.0
3	70.6	94.2	77.4	114.4	84.2	92.7
4	69.6	85.0	70.6	88.4	90.3	83.4
5						
6						
<u>N</u> Approach	100.0	67.0	64.4	72.1	70.8	68.6
Average	479.2	88.0	84.8	95.6	79.3	86.9

Remarks Joints and spans numbered from south to north. Joint #1, 2, and 3 - Expansion;
#4 - Construction; #5 - Expansion; #6 - Steel Expansion; #7 - Expansion; #8 - Construction;
#9, 10, and 11 - Expansion.

Concrete approaches.

Some tar and chips on bridge.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S07 of 73171, Location Girmus Road over I 75

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 4 Machine Finished Yes No

E Bound Roadway

Date Measured 8-24-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	100.9	29.0			64.4
Span 1	33.8	144.5	185.1			165.6
2	74.7	100.0	111.0			105.3
3	73.8	104.0	116.6			110.2
4	36.7	121.6	154.0			138.1
5						
6						
<u>E</u> Approach	50.0	80.2	53.3			66.5
Average	319.0	105.1	103.2			104.3

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	56.5	59.2			58.1
Span 1	33.8	150.7	101.6			126.5
2	74.7	102.2	101.4			101.8
3	73.8	119.5	108.7			114.5
4	36.7	189.9	192.8			191.3
5						
6						
<u>E</u> Approach	50.0	131.4	92.9			111.9
Average	319.0	118.8	105.6			112.2

Remarks Joints and spans numbered from west to east. Joint #1 - Construction, #2 - Expansion; #3 - Steel Expansion; #4 - Expansion; #5 - Construction.

Bituminous approaches.

Drops of tar scattered on bridge.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S08 of 73171, Location I 75 over US 10
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 3 Machine Finished Yes No

S Bound Roadway

Date Measured 8-22-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	100.0	73.9	71.0	62.3	79.0	71.8
Span 1	49.5	150.4	116.8	161.0	171.8	150.4
2	105.0	123.2	98.8	131.0	140.0	124.7
3	48.4	136.9	132.6	177.2	157.6	150.5
4						
5						
6						
<u>N</u> Approach	100.0	88.2	61.2	102.4	78.4	82.4
Average	402.9	107.2	88.8	116.0	117.2	107.3

N Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	100.0	78.4	76.8	76.8	71.6	76.0
Span 1	49.5	137.6	160.0	108.2	92.2	124.8
2	105.0	98.4	90.5	105.4	109.4	101.1
3	48.4	150.0	134.2	126.0	109.1	129.8
4						
5						
6						
<u>N</u> Approach	100.0	86.0	103.0	75.8	82.9	87.1
Average	402.9	101.3	104.0	93.8	91.2	97.6

Remarks Spans and joints numbered from south to north. Joint #1, 2, and 3 - Expansion; #4 - Construction; #5 - Expansion; #6 - Steel Expansion; #7 - Construction; #8, 9, and 10 - Expansion.

Concrete approaches.

Some tar and stones on bridge.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number X02 of 76023, Location M 78 over G. T. W. R.

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 3 Machine Finished Yes No

E Bound Roadway

Date Measured 11-30-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	100.0	100.6	117.8	119.8	127.0	116.2
Span 1	59.7	128.2	166.8	147.7	114.1	138.9
2	59.7	127.8	171.6	107.5	80.0	122.0
3	56.8	157.6	120.6	113.2	128.8	129.7
4						
5						
6						
<u>E</u> Approach	100.0	140.2	137.2	163.9	119.3	140.4
Average	376.2	128.9	140.2	133.0	116.2	129.6

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	100.0	115.6	123.6	109.3	117.8	116.2
Span 1	57.9	143.6	142.7	133.6	128.2	136.8
2	57.9	145.9	172.8	127.2	143.2	147.7
3	56.8	151.0	206.8	148.3	193.4	174.8
4						
5						
6						
<u>E</u> Approach	100.0	121.7	109.6	88.0	131.8	113.0
Average	376.2	130.6	141.8	115.0	137.4	131.1

Remarks Spans and joints numbered from west to east; Joint #1, 2, 3 - Expansion;
#4 - Construction; #5 - Expansion; #6 - Steel Expansion; #7 - Construction; #8, 9, 10 -
Expansion.

P.O.B. & P.O.E. of spans are on piers.

Mudjacking and cracking on approaches.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S03 of 76023, Location Grand River over M 78

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 4 Machine Finished Yes No

S Bound Roadway

Date Measured 7-26-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>S</u> Approach						
Span 1	53.1	114.8	73.6			94.5
2	126.8	111.0	75.6			93.3
3	126.8	79.8	72.0			75.8
4	50.6	104.8	95.5			100.2
5						
6						
<u>N</u> Approach						
Average	357.3	99.6	76.8			88.1

N Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>S</u> Approach						
Span 1	53.1	104.9	72.1			88.5
2	126.8	105.4	82.9			94.1
3	126.8	103.2	70.8			87.0
4	50.6	59.4	57.4			58.4
5						
6						
<u>N</u> Approach						
Average	357.3	98.0	73.4			85.7

Remarks Joints and spans numbered from south to north. Joint #1 - Expansion; #2 - Steel Expansion; #3 - Construction; #4 - Steel Expansion; #5 - Expansion.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S05 of 76023, Location Newbury Road over M 78
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

E Bound Roadway

Date Measured 9-18-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach						
Span 1	43.9	98.0	95.6			96.2
2	92.8	153.4	193.4			173.5
3	91.5	122.4	132.7			127.5
4	39.7	122.4	122.4			122.4
5						
6						
<u>E</u> Approach						
Average	267.9	129.1	146.2			137.6

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach						
Span 1	43.9	125.7	117.3			121.5
2	92.8	128.8	107.8			118.4
3	91.5	158.4	135.0			146.6
4	39.7	95.8	97.8			97.1
5						
6						
<u>E</u> Approach						
Average	267.9	133.5	117.2			125.4

Remarks Joints numbered from west to east. Joint #1 - expansion; #2 - steel expansion; #3 - expansion.

Approaches too rough to run.

Spans 1 and 2 are super-elevated.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S07 of 76023, Location M-71 over M-78
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

N Bound Roadway

Date Measured 12/4/62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	100.0	111.4	84.2			97.7
Span 1	34.0	188.7	132.0			160.0
2	84.1	131.6	112.7			121.8
3	84.4	126.4	146.0			135.8
4	32.8	120.7	127.2			124.0
5						
6						
<u>N</u> Approach	100.0	133.4	102.4			117.7 x
Average	435.3	130.0	112.8			121.4

S Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	100.0	116.4	123.8			120.4
Span 1	34.0	215.1	211.2			214.3
2	84.1	136.8	129.4			133.1
3	84.4	125.4	131.4			128.2
4	32.8	161.0	169.0			177.1
5						
6						
<u>N</u> Approach	100.0	76.0	84.0			80.3
Average	435.3	125.2	127.4			126.3

Remarks Joints and spans numbered from south to north.

P.O.B. and P.O.E. of spans are over piers.

District 6
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S08 of 76023, Location Durand Road over M 78

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 5 Machine Finished Yes No

N Bound Roadway Date Measured 8-2-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
Approach						
Span 1	58.1	154.0	126.8			140.0
2	86.1	229.0	134.9			182.1
3	62.8	162.7	159.3			161.4
4	85.7	100.1	104.4			102.3
5	63.4	88.7	77.0			83.3
6						
Approach						
Average	356.1	149.1	120.3			134.7

S Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
Approach						
Span 1	58.1	117.2	87.7			102.7
2	86.1	140.1	140.7			140.4
3	62.8	90.8	124.0			107.6
4	85.7	133.7	108.1			120.8
5	63.4	115.3	124.1			119.9
6						
Approach						
Average	356.1	121.8	118.3			120.1

Remarks Joints number from south to north.

District 7
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S01 of 11015, Location I-94 over US-12 (EB Only)

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 4 Machine Finished Yes No

E Bound Roadway Date Measured 8/7/62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	93.4	92.9	135.2	180.6	125.7
Span 1	43.9	163.6	104.6	160.6	128.7	139.5
2	72.7	102.4	77.4	82.8	89.6	87.8
3	72.7	107.8	122.0	97.6	136.4	116.2
4	49.6	121.8	85.2	120.8	84.1	103.2
5						
6						
<u>E</u> Approach	100.0	65.4	70.5	90.0	101.6	81.8
Average	388.9	102.2	90.0	107.8	116.8	104.2

 Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u> </u> Approach						
Span 1						
2						
3						
4						
5						
6						
<u> </u> Approach						
Average						

Remarks Joints numbered from west to east. Joint #1 - construction; #2 - steel expansion; #3 - expansion; #4 - steel expansion; #5 - construction.

Bituminous approaches.

District 7
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S02 of 11015, Location I-94 over US-12 (WB only)

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 4 Machine Finished Yes No

W Bound Roadway

Date Measured 8/7/62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>E</u> Approach	100.0	48.3	40.6	55.4	44.1	47.1
Span 1	49.6	111.3	118.8	122.4	150.2	125.7
2	72.7	133.6	108.2	131.4	132.6	126.5
3	72.7	126.0	87.6	81.0	122.0	104.1
4	43.9	154.6	100.4	137.1	123.3	128.8
5						
6						
<u>W</u> Approach	100.0	77.9	66.6	38.8	66.0	62.3
Average	438.9	99.8	80.3	84.2	96.5	90.2

 Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u> </u> Approach						
Span 1						
2						
3						
4						
5						
6						
<u> </u> Approach						
Average						

Remarks Joints and spans are numbered from east to west.

Joint #1 - construction; #2 - steel expansion; #3 - expansion; #4 - steel expansion;
#5 - construction.

Bituminous approaches.

District 7
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S05 of 11015, Location Lakeside Road over I 94

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 4 Machine Finished Yes No

W Bound Roadway

Date Measured 8 - 8 - 62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	50.0	108.8	70.8			89.8
Span 1	61.9	152.2	119.0			135.6
2	98.4	142.7	108.7			125.6
3	87.2	90.5	97.8			94.5
4	74.9	123.4	95.2			109.3
5						
6						
<u>E</u> Approach	50.0	148.4	120.9			133.1
Average	422.4	126.6	102.6			114.5

E Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	133.0	156.2			144.7
Span 1	61.9	181.2	167.2			174.0
2	98.4	133.9	157.0			145.4
3	87.2	144.8	143.2			144.1
4	74.9	139.6	137.8			138.9
5						
6						
<u>E</u> Approach	50.0	71.3	90.8			81.3
Average	422.4	135.9	144.4			140.1

Remarks Joints and spans numbered from west to east. Joint #1 - Construction; #2 - Expansion; #3 - Steel Expansion; #4 - Expansion #5 - Construction.

Bituminous approaches.

Some tar on bridge deck.

District 7
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Bridge Number S08 11015, Location Three Oaks Rd. over I 94 Form 511
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

N Bound Roadway Date Measured 8-8-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>S</u> Approach	50.0	84.4	51.7			68.0
Span 1	41.9	126.0	163.8			144.9
2	89.1	99.8	113.2			106.5
3	89.3	82.5	102.0			92.2
4	40.5	130.4	176.0			153.2
5						
6						
<u>N</u> Approach	50.0	96.1	70.2			83.1
Average	360.8	99.4	103.8			101.5

S Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>S</u> Approach	50.0	91.4	111.4			101.3
Span 1	41.9	112.8	130.4			121.5
2	89.1	115.3	109.9			112.6
3	89.3	93.4	76.0			84.7
4	40.5	158.4	214.4			186.4
5						
6						
<u>N</u> Approach	50.0	113.0	108.2			110.6
Average	360.8	110.8	115.6			113.1

Remarks Joints and spans numbered from south to north. Joint #1 - construction;
#2 - expansion; #3 - steel expansion; #4 - expansion; #5 - construction.
Bituminous approaches.
Some tar on bridge deck.

District 7
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S09 of 11015, Location Harbert Road over I 94
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

W Bound Roadway

Date Measured 8-9-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>W</u> Approach						
Span 1	39.7	78.5	61.8			69.2
2	73.1	70.8	102.7			86.7
3	73.4	134.5	138.4			134.5
4	33.5	57.5	109.5			83.5
5						
6						
<u>E</u> Approach						
Average	219.7	90.2	108.2			99.2

E Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>W</u> Approach						
Span 1	39.7	109.0	85.1			97.1
2	73.1	69.0	88.8			78.7
3	73.4	107.8	126.6			117.2
4	33.5	122.2	87.4			104.0
5						
6						
<u>E</u> Approach						
Average	219.7	97.3	100.6			98.8

Remarks Joints and spans numbered from west to east. Joint #1 - Construction; #2 - Expansion; #3 - Steel Expansion; #4 - Expansion; #5 - Construction.

Bituminous approaches.

District 7
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S11 of 11015, Location Browntown Road over I 94

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 4 Machine Finished Yes No

E Bound Roadway

Date Measured 8-9-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>N</u> Approach	50.0	125.6	98.8			111.9
Span 1	46.4	61.4	101.8			81.9
2	77.0	81.0	71.3			76.1
3	76.9	82.7	89.3			85.8
4	48.1	76.8	104.8			91.1
5						
6						
<u>E</u> Approach	50.0	136.8	75.0			105.6
Average	348.4	92.6	88.3			90.4

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	50.0	111.4	86.0			99.3
Span 1	46.4	80.8	99.6			89.9
2	77.0	96.0	74.4			85.0
3	76.9	71.8	62.4			67.3
4	48.1	109.8	109.2			109.8
5						
6						
<u>E</u> Approach	50.0	59.6	131.4			95.0
Average	348.4	87.5	89.8			88.6

Remarks Spans and joints numbered from west to east. Joint #1 - Construction; #2 - Steel Expansion; #3 - Expansion; #4 - Steel Expansion; #5 - Construction.

Bituminous approaches.

District 8
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Bridge Number B01 of 23151, Location I-96 over Grand River (EB Only) Form 511
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 3 Machine Finished Yes No

E Bound Roadway

Date Measured 12/13/62

Item	Length	Profilometer Roughness Value - R inches per mile				
		Traffic Lane		Passing Lane		Average
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>W</u> Approach	100.0	100.8	108.5	83.4	85.7	94.5
Span 1	126.1	120.6	119.2	85.4	125.2	112.9
2	142.5	116.0	105.8	78.6	102.4	100.4
3	127.7	118.8	101.1	78.0	97.3	98.4
4						
5						
6						
<u>E</u> Approach	100.0	93.0	69.7	57.6	54.2	68.1
Average	596.3	111.1	101.9	77.0	95.1	96.1

 Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				
		Traffic Lane		Passing Lane		Average
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u> </u> Approach						
Span 1						
2						
3						
4						
5						
6						
<u> </u> Approach						
Average						

Remarks P.O.B. and P.O.E. of spans are not over piers.

District 8
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Bridge Number B02 of 23151, Location I 96 over Grand River (WB Only) Form 511
Dual Structures (separate for each roadway) Yes No
Single Structure Yes No
Number of Spans 3 Machine Finished Yes No

W Bound Roadway

Date Measured 11-26-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	100.0	88.3	65.6	65.6	67.4	71.9
Span 1	95.7	113.7	88.3	105.6	107.8	103.7
2	110.4	107.6	100.7	96.0	100.7	100.9
3	95.7	111.5	50.8	92.4	124.4	94.9
4						
5						
6						
<u>E</u> Approach	100.0	60.7	56.7	69.3	70.0	64.1
Average	501.8	96.5	73.3	86.1	94.0	87.5

 Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u> </u> Approach						
Span 1						
2						
3						
4						
5						
6						
<u> </u> Approach						
Average						

Remarks All spans and joints numbered from west to east. Joint #1, 2, 3 - expansion; #4 - construction; #5 - steel expansion; #6 - expansion; #7 - construction; #8, 9, 10 - expansion.

District 8
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number B01 of 23152, Location I 96 over Grand River

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 3 Machine Finished Yes No

East: 12-3-62

W Bound Roadway Date Measured West: 12-1-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	100.0	105.0	104.0	128.6	137.8	118.8
Span 1	86.8	207.2	222.3	235.7	212.0	219.3
2	94.0	190.1	212.0	202.8	207.6	203.1
3	86.5	160.9	147.4	116.9	120.4	136.4
4						
5						
6						
<u>E</u> Approach	100.0	89.2	67.0	78.6	57.3	72.9
Average	467.3	148.1	147.8	151.0	145.1	147.9

E Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>W</u> Approach	100.0	146.8	119.6	75.8	71.8	103.0
Span 1	86.8	159.0	138.7	147.8	158.4	150.8
2	94.0	234.2	179.8	187.6	158.2	189.8
3	86.5	156.0	136.1	143.8	126.0	140.4
4						
5						
6						
<u>E</u> Approach	100.0	75.2	79.7	79.0	72.9	76.6
Average	467.3	153.0	129.8	125.0	115.5	127.0

Remarks Joints and spans numbered from west to east. Joint #1, 2, and 3 - Expansion;
#4 - Construction; #5 - Steel Expansion; #6 - Expansion; #7 - Construction; #8, 9, and 10 -
Expansion.

P.O.B. and P.O.E. of spans are not joints over piers.

District 8
 PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
 TEST RESULT TABULATION
 Research Project 61 F-65

Bridge Number S01 of 33084, Location Aurelius Road over I 96 Form 511
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

S Bound Roadway

Date Measured 9-27-62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>S</u> Approach	50.0	178.5	203.8			191.1
Span 1	38.5	207.1	135.1			171.4
2	76.3	127.3	90.6			109.3
3	75.4	107.1	101.2			104.3
4	39.0	151.0	125.9			138.1
5						
6						
<u>N</u> Approach	50.0	128.3	65.0			97.2
Average	329.2	142.8	115.8			129.3

N Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>S</u> Approach	50.0	148.9	127.2			138.3
Span 1	38.5	211.8	153.6			182.4
2	76.3	97.6	118.0			108.0
3	75.4	98.0	99.4			98.7
4	39.0	224.8	173.3			199.0
5						
6						
<u>N</u> Approach	50.0	118.8	97.2			107.7
Average	329.2	137.2	122.7			129.9

Remarks Joints and spans numbered from south to north. Joint #1 - Construction; #2 - Expansion; #3 - Steel Expansion; #4 - Expansion; #5 - Construction.

Bituminous approaches.

District 8
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S07 of 33084, Location Okemos Road over I-96
 Dual Structures (separate for each roadway) Yes No
 Single Structure Yes No
 Number of Spans 4 Machine Finished Yes No

S Bound Roadway

Date Measured 11/26/62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>S</u> Approach	100.0	122.0	100.6			110.9
Span 1	37.5	152.0	108.4			129.5
2	80.9	92.6	91.4			92.0
3	79.7	82.2	74.2			78.2
4	37.5	134.5	134.5			133.8
5						
6						
<u>N</u> Approach	100.0	117.4	57.8			87.6
Average	433.6	111.8	87.8			99.8

N Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O.W.P.	I.W.P.	O.W.P.	I.W.P.	
<u>S</u> Approach	100.0	109.6	110.1			109.8
Span 1	37.5	151.4	156.3			153.5
2	80.9	121.0	91.7			106.4
3	79.7	97.4	81.8			89.4
4	37.5	121.8	136.6			128.1
5						
6						
<u>N</u> Approach	100.0	99.2	98.4			98.7
Average	433.6	111.8	105.0			108.4

Remarks Joints numbered from south to north.

Joints #1, 2 and 3 - expansion; #4 - construction; #5 - expansion; #6 - steel expansion;
#7 - expansion; #8 - construction; #9, 10 and 11 - expansion.

PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS

TEST RESULT TABULATION

Research Project 61 F-65

Bridge Number S03 of 33085, Location Elm Road over I-96 Form 511

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 4 Machine Finished Yes No

S Bound Roadway

Date Measured 9/27/62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	50.0	128.9	220.7			175.3
Span 1	37.6	125.0	114.4			119.3
2	70.8	89.8	97.4			94.0
3	70.9	96.0	106.8			101.3
4	37.7	120.4	114.8			117.6
5						
6						
<u>N</u> Approach	50.0	182.6	143.1			162.6
Average	317.0	119.8	130.3			125.1

N Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	50.0	167.9	152.6			160.5
Span 1	37.6	91.2	75.1			82.8
2	70.8	76.4	61.2			68.6
3	70.9	114.0	86.4			99.8
4	37.7	149.1	99.4			124.6
5						
6						
<u>N</u> Approach	50.0	145.2	112.0			128.8
Average	317.0	120.5	95.4			108.1

Remarks Joints numbered from south to north. Joint #1 - construction; #2 - expansion; #3 - expansion; #4 - expansion; #5 - construction.

Centerline of joints are ends of spans

Bituminous approaches

District 8
PROFILOMETER BRIDGE ROUGHNESS MEASUREMENTS
TEST RESULT TABULATION
Research Project 61 F-65

Form 511

Bridge Number S09 of 81103, Location US-23 Br. near Ann Arbor

Dual Structures (separate for each roadway) Yes No

Single Structure Yes No

Number of Spans 3 Machine Finished Yes No

N Bound Roadway

Date Measured 11/29/62

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	100.0	80.5	84.7	99.0	77.9	85.5
Span 1	79.9	89.5	72.7	104.1	68.7	83.9
2	150.4	76.7	79.5	87.8	116.7	90.2
3	66.7	111.6	139.7	92.6	87.5	107.7
4						
5						
6						
<u>N</u> Approach	100.0	102.4	110.1	105.1	88.4	101.4
Average	497.0	92.8	97.2	100.4	95.0	96.3

S Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Traffic Lane		Passing Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
<u>S</u> Approach	100.0	119.6	121.7	93.5	99.8	108.8
Span 1	35.6	161.6	163.8	135.7	94.2	139.4
2	54.3	114.2	119.1	110.8	89.0	107.9
3	35.8	124.6	123.2	175.4	151.2	143.1
4						
5						
6						
<u>N</u> Approach	100.0	89.2	129.8	67.4	82.6	92.4
Average	325.7	114.6	128.6	102.0	99.8	110.7

Remarks Joints and spans numbered from south to north. Joint No. 1, 2 and 3 - expansion; No. 4 - construction; No. 5 - expansion, No. 6 - steel expansion; No. 7 - construction; No. 8, 9 and 10 - expansion.