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**PROFILOMETER MEASUREMENT OF BRIDGE ROUGHNESS**  
**Seventh Progress Report**

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**Research Laboratory Division**  
**Office of Testing and Research**  
**Research Project 61 F-65**  
**Research Report No. R-542**

**Michigan State Highway Department**  
**Lansing, November 1965**

PROFILOMETER MEASUREMENT OF BRIDGE ROUGHNESS  
Seventh Progress Report

This is the seventh and final publication of a series on profilometer measurement of the roughness of bridge decks. With this report, a total of 203 bridge projects have been reported. The first progress report in this series (Research Report No. R-421) described the profilometer equipment, gave procedures for testing and data analysis, and included measurements for 35 bridge projects. The second (Research Report No. R-430) reported measurements for an additional 22 bridge projects, including one structure of a project partially reported in the first report. The third (Research Report No. R-433) reported results for another 34 bridge projects and gave an updated analysis and evaluation of all bridge projects analyzed in this research program through November 1963. In that report, it was observed that as more project data became available, it was increasingly clear that no significant differences in surface roughness exist between hand-finished and transverse machine-finished bridge decks. The fourth (Research Report No. R-450) reported results for 35 more bridge projects and included an analysis of the effect of the deck beam type used in a bridge's construction on its relative roughness. The fifth progress report (Research Report No. R-469) presented results for a group of 20 bridge projects (23 separate structures). The sixth (Research Report No. R-492) included 41 bridge projects (49 separate structures). This seventh report presents results for a new group of 16 bridge projects (21 separate structures). Two bridges, B02 of 33061 and S34 of 82112, have previously been reported separately and are included here to complete the full series of reported structures.

In this report the same riding quality classification is used as before, expressed in terms of accumulated inches per mile:

"Good" = less than 100  
"Average" = 100 to 160  
"Poor" = over 160

Using these categories, the 89 "span-run" values (see Glossary), and the 21 "structure" values (see Glossary), measured for the 16 bridge

projects for which test result forms are presented in this report, may be classified as follows:

Finishing Method	Riding Quality							
	Span Runs				Structures			
	Good	Average	Poor	Total	Good	Average	Poor	Total
Hand	33	24	10	67	8	10	0	18
Transverse Machine	0	4	0	4	0	1	0	1
Longitudinal Machine	3	0	0	3	1	0	0	1
Bid-Well Machine	11	4	0	15	1	0	0	1
Totals	47	32	10	89	10	11	0	21

### Summary Remarks on Finishing Methods in Relation to Roughness

In completing this series of publications, a summary remark seems desirable concerning the principal comparison discussed in these progress reports. On the basis of all information now available, new cumulative frequency distributions of "span values" (see Glossary) are illustrated in Fig. 1. These curves for average roughness of span surfaces finished by various methods confirm previous conclusions, and indicate the following contributing factors to surface smoothness:

1. On the basis of three longitudinally finished bridge decks that have now been measured, it appears that this technique results in significantly smoother surfaces. The average roughness value for the bridges finished by this method is 64 in. per mile, much less than the hand-finished bridge average of 124 in. per mile, or the transverse-machine finished bridge average of 128 in. per mile.

2. Another special type of machine (Bid-Well) also produced somewhat smoother decks. Three bridges finished in this manner had an average roughness value of 96 in. per mile. Both the longitudinal and the Bid-Well finishing machines produced average roughness values within the "good" category of riding quality, although data indicate that the former gave significantly smoother results.

3. Differences in roughness resulting from finishing by hand or by transverse machine are not significant. This is also apparent in Fig. 2, where fitted frequency curves are presented of roughness distributions for complete structures rather than individual spans. No meaningful superiority of one finishing method over another is shown by either graphical comparison.

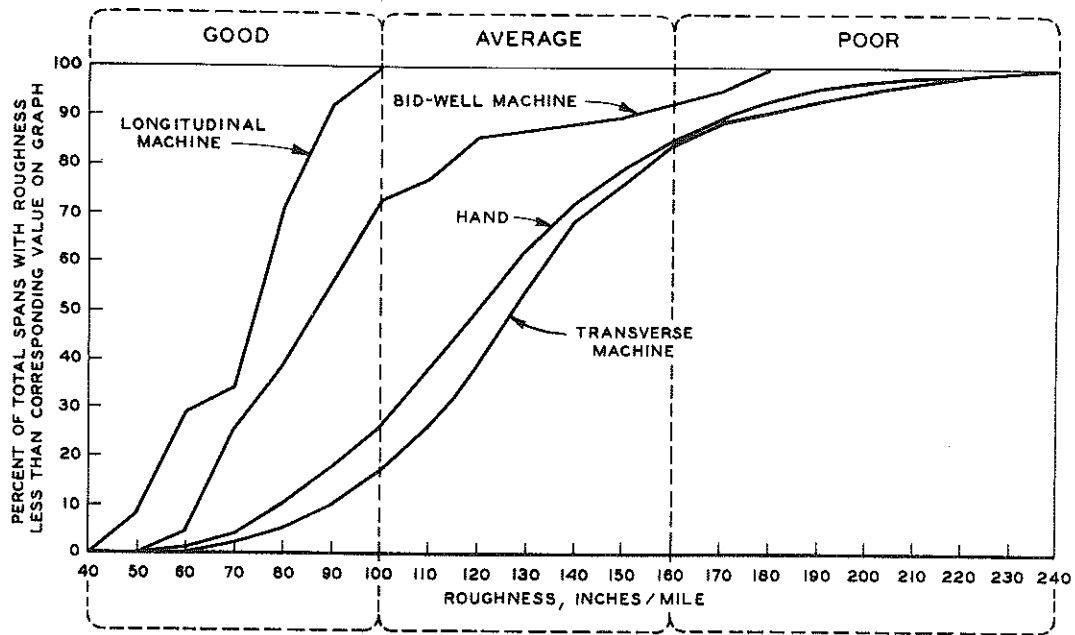


Figure 1. Cumulative frequency distributions of span values in relation to method of deck finishing.

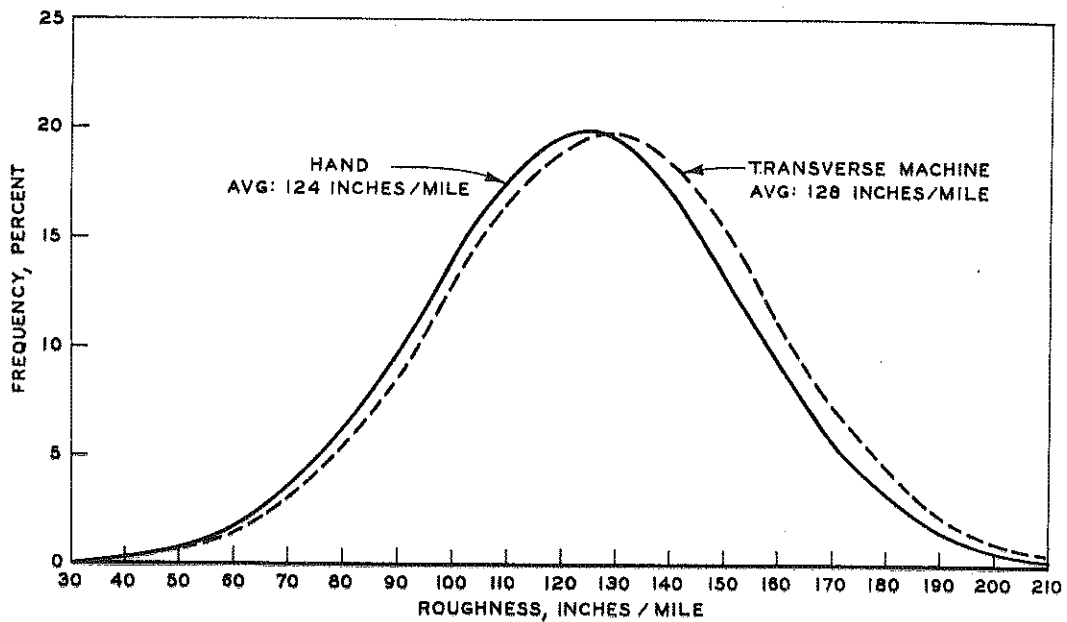


Figure 2. Distributions of structure roughness in relation to method of deck finishing.

## Summary Remarks on Deck Support in Relation to Roughness

Another previously reported comparison for which an updated analysis of data is desirable in completing this report series, is roughness variation in relation to type of deck support. In the fourth progress report, a preliminary evaluation of 117 projects was discussed. It was inferred tentatively that a difference in mean roughness values did exist for bridge decks supported by deck plate girders, prestressed concrete I-beams, or steel I-beams. The range of the mean values was 17 in. per mile, and was within the "average" (100 to 160 in. per mile) category of riding quality.

Data now available from 187 structures are adequate for further comparison of the same three structural types previously examined:

1. Deck plate girders (40 structures)
2. Prestressed concrete I-beams (24 structures)
3. Steel I-beams (123 structures).

Frequency distributions of structure values for these three beam types are plotted in Fig. 3. Based on these sample data, statistical evaluation now indicates no significant difference in average roughness values. The range (13 in. per mi.) is smaller than in the previous analysis, but still within the "average" category of riding quality.

On the other hand, of structures supported by prestressed concrete I-beams, 37 percent have roughness values falling within the "good" category. This may be compared with only 11 percent for deck plate girders, and 17 percent for steel I-beams. Further, the distribution of roughness values for prestressed concrete I-beams is skewed to the right, differing markedly in form from those of the other two deck support types. These facts suggest that an actual difference in distribution form and mean may exist for roughness of such structures. Further measurements of additional structures of this type would be necessary to demonstrate a statistically significant relationship between greater deck smoothness and use of such beams.

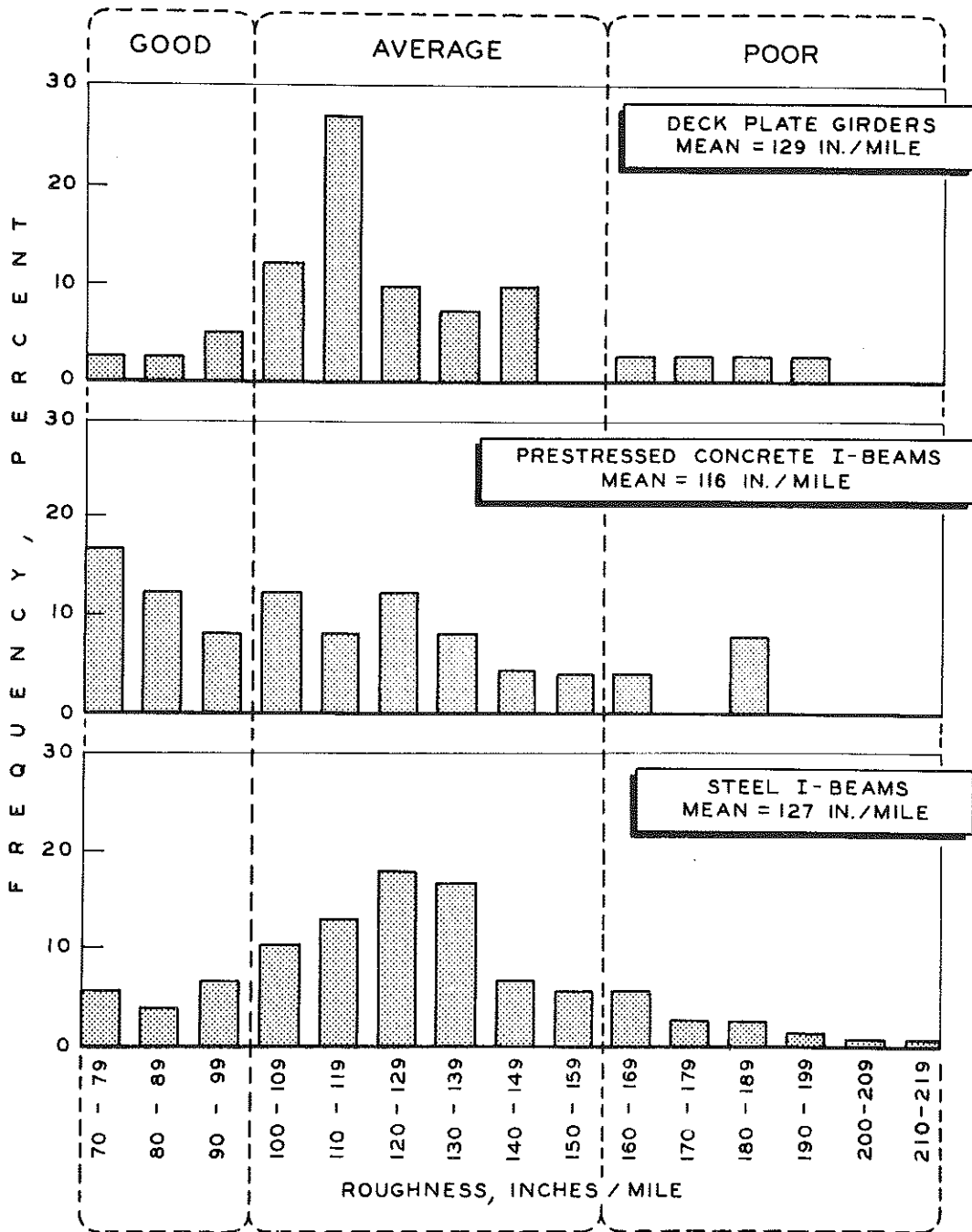


Figure 3. Distributions of structure values for types of deck support.

## GLOSSARY

**BRIDGE PROJECT:** used in this report series to refer to the Department's standard identification by construction project number, sometimes involving more than one structure. It should be noted that roughness is analyzed and reported in terms of "span," "span run," or "structure" values.

**IWP:** inner wheel path, in relation to the structure's centerline.

**OWP:** outer wheel path, in relation to the structure's centerline.

**ROUGHNESS:** riding quality of the deck lane surfaces, measured in accumulated inches and converted or prorated to inches per mile (in. per mi.).

**SPAN VALUE:** average of wheel path roughness measurements for all lanes of a given span.

**SPAN RUN VALUE:** roughness measurement for one wheel path on a given span.

**STRUCTURE VALUE:** roughness measurement (weighted mean) computed from values obtained from all spans and all wheel paths for a particular structure.

**WEIGHTED MEAN:** for this study, the arithmetic mean computed from individual span run roughness values, weighted according to span length.

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

Form 1011

Bridge No. S04 of 03034 Location US 31 over I 96  
Date Measured 9-23-64 Number of Spans 4 Length (including approaches) 476.2  
Dual Structures (separate for each roadway) Yes  No   
Single Structure Yes  No  Method of Finishing Hand  
NB 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.	
Span 1	38.4	197	213			205
2	94.0	103	82			92
3	95.4	140	102			121
4	48.4	162	107			134
5						
6						
Weighted Average for Bridge		139	112			126
NB Approach	100.0	76	73			74
SB Approach	100.0	75	82			78
Weighted Average for Bridge and Approaches		113	97			105

SB 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.	
Span 1	38.4	165	126			146
2	94.0	125	113			119
3	95.4	101	72			86
4	48.4	152	102			127
5						
6						
Weighted Average for Bridge		127	99			113
NB Approach	100.0	66	71			68
SB Approach	100.0	72	85			78
Weighted Average for Bridge and Approaches		103	90			96

Remarks Spans and Joints numbered from South to North. Joint number and type: #1, 3, 5, 7 - expansion; #2, 6 - construction; #4 - steel expansion.

Cantilevered.

Concrete approaches.



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

Form 1011

Bridge No. B02 of 33061 Location Oakland Avenue over the Grand River  
Date Measured 1-6-65 Number of Spans 3 Length (including approaches) 479.0  
Dual Structures (separate for each roadway) Yes  No   
Single Structure Yes  No  Method of Finishing Longitudinal Machine  
W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Lane 1		Lane 2		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
Span 1	89.0	40	44	42	41	
2	100.5	111	72	109	83	
3	89.5	46	47	51	23	
4						
5						
6						
Weighted Average for Bridge		67	55	69	50	
E Approach	100.0	76	43	88	79	
W Approach	100.0	58	62	59	68	
Weighted Average for Bridge and Approaches						

W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile				Average
		Lane 3		Lane 4		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	
Span 1	89.0	52	61	61	110	56
2	100.5	75	82	72	75	85
3	89.5	80	41	43	52	48
4						
5						
6						
Weighted Average for Bridge		69	62	59	79	64
E Approach	100.0	68	76	86	120	80
W Approach	100.0	73	69	108	114	76
Weighted Average for Bridge and Approaches		70	66	75	95	70

Remarks Spans numbered from West to East. Joint Number and Type: #1, 2, 3, 6, 8 - Expansion; #4, 7 - Construction; #5 - Steel Expansion.  
Lanes numbered from North to South.  
Concrete Approaches.

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

Form 1011

Bridge No. S01 of 39014 Location "M" Ave. over US 131  
Date Measured 1-11-65 Number of Spans 4 Length (including approaches) 343.9  
Dual Structures (separate for each roadway) Yes  No   
Single Structure Yes  No  Method of Finishing Hand  
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.	
Span 1	34.7	81	82			82
2	83.7	80	68			74
3	83.0	128	122			125
4	42.5	125	106			116
5						
6						
Weighted Average for Bridge		105	95			100
W Approach	50.0	252	292			272
E Approach	50.0	176	172			174
Weighted Average for Bridge and Approaches		136	135			136

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.	
Span 1	34.7	113	110			112
2	83.7	100	63			82
3	83.0	85	92			88
4	42.5	122	117			120
5						
6						
Weighted Average for Bridge		101	89			95
W Approach	50.0	176	133			154
E Approach	50.0	174	260			217
Weighted Average for Bridge and Approaches		122	120			121

Remarks Spans and joints numbered from West to East. Joint number and type: #1, 5 construction; #2 steel expansion; #3, 4 steel expansion.

Bituminous Approaches.

Blowup in the West approach (EBTL-OWP)

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

Form 1011

Bridge No. S05 of 39014 Location Michigan Ave. over US 131  
Date Measured 10-23-64 Number of Spans 4 Length (including approaches) 402.0  
Dual Structures (separate for each roadway) Yes  No   
Single Structure Yes  No  Method of Finishing Hand  
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.	
Span 1	55.2	75	51			63
2	90.3	89	74			82
3	91.0	101	65			83
4	65.5	77	61			69
5						
6						
Weighted Average for Bridge		87	64			76
W Approach	50.0	208	141			174
E Approach	50.0	130	70			100
Weighted Average for Bridge and Approaches		108	75			92

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.	
Span 1	55.2	92	69			80
2	90.3	84	84			84
3	91.0	72	72			72
4	65.5	74	59			66
5						
6						
Weighted Average for Bridge		80	72			76
W Approach	50.0	135	126			130
E Approach	50.0	123	109			116
Weighted Average for Bridge and Approaches		92	76			84

Remarks Spans and Joints numbered from West to East. Joint number and type: #1, 5 - construction; #2, 4 - steel expansion; #3 - expansion.

Cantilevered structure.

Bituminous approaches.

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

Form 1011

Bridge No. S08 of 39014 Location US 131 SB over US 131 NB

Date Measured 10-14-64 Number of Spans 3 Length (including approaches) 418.0

Dual Structures (separate for each roadway) Yes  No

Single Structure Yes  No  Method of Finishing Hand

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.	
Span 1	54.0	127	113	251	190	170
2	96.0	153	104	142	178	144
3	68.0	179	147	166	151	161
4						
5						
6						
Weighted Average for Bridge		155	120	176	172	156
S Approach	100.0	90	85	95	77	87
N Approach	100.0	102	85	83	58	82
Weighted Average for Bridge and Approaches		126	103	135	122	122

         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.	
Span 1						
2						
3						
4						
5						
6						
Weighted Average for Bridge						
Approach						
Approach						
Weighted Average for Bridge and Approaches						

Remarks Spans and Joints numbered from South to North. Joint number and type: #1, 2, 3, 5, 8, 9 - expansion; #4, 7 - construction; #6 - steel expansion.

Concrete approaches.

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

Form 1011

Bridge No. S09 of 39014 Location Ravine Rd over US 131  
Date Measured 10-23-64 Number of Spans 4 Length (including approaches) 419.6  
Dual Structures (separate for each roadway) Yes  No   
Single Structure Yes  No  Method of Finishing Hand  
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.	
Span 1	79.0	135	123			129
2	89.6	97	98			98
3	91.0	75	88			82
4	60.0	104	101			102
5						
6						
Weighted Average for Bridge		101	102			102
W Approach	50.0	152	138			145
E Approach	50.0	207	236			222
Weighted Average for Bridge and Approaches		120	122			121

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.	
Span 1	79.0	131	142			136
2	89.6	107	76			92
3	91.0	125	100			112
4	60.0	163	164			164
5						
6						
Weighted Average for Bridge		129	116			122
W Approach	50.0	181	238			210
E Approach	50.0	168	245			206
Weighted Average for Bridge and Approaches		140	146			143

Remarks Spans and Joints numbered from West to East. Joint number and type: #1, 5 - construction; #2, 4 - expansion; #3 - steel expansion.  
Bituminous approaches.

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

Form 1011

Bridge No. S10 of 39014 Location US 131 (SB) over "D" Avenue

Date Measured 10-14-64 Number of Spans 3 Length (including approaches) 310.2

Dual Structures (separate for each roadway) Yes  No

Single Structure Yes  No  Method of Finishing Hand

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.	
Span 1	35.4	83	103	67	89	86
2	40.8	50	66	76	77	67
3	34.0	121	93	128	135	119
4						
5						
6						
Weighted Average for Bridge		82	86	89	99	89
S Approach	100.0	64	87	84	90	81
N Approach	100.0	123	111	85	101	105
Weighted Average for Bridge and Approaches		90	95	86	96	92

         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.	
Span 1						
2						
3						
4						
5						
6						
Weighted Average for Bridge						
Approach						
Approach						
Weighted Average for Bridge and Approaches						

Remarks Spans and Joints numbered from South to North. Joint number and type: #1, 2, 3, 5, 6, 8, 9, 10 - expansion; #4, 7 - construction.

Concrete approaches.

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

Form 1011

Bridge No. X01 of 39014 Location US 131 over NYC RR and "KL" Avenue  
Date Measured 10-13-64 Number of Spans 5 Length (including approaches) 505.2  
Dual Structures (separate for each roadway) Yes  No   
Single Structure Yes  No  Method of Finishing Hand  
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.	
Span 1	56.3	130	124	108	93	114
2	61.0	120	78	103	99	100
3	61.0	81	57	72	95	76
4	60.3	73	52	71	88	71
5	66.6	62	46	94	94	74
6						
Weighted Average for Bridge		92	70	90	94	86
S Approach	100.0	132	103	87	71	98
N Approach	100.0	143	78	130	127	120
Weighted Average for Bridge and Approaches		110	78	97	96	95

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.	
Span 1	56.3	126	107	140	122	124
2	61.0	97	105	95	81	94
3	61.0	56	49	72	121	74
4	60.3	92	84	65	66	77
5	66.6	110	111	97	106	106
6						
Weighted Average for Bridge		96	91	93	99	95
S Approach	100.0	127	110	64	80	95
N Approach	100.0	81	58	65	72	69
Weighted Average for Bridge and Approaches		99	89	82	90	90

Remarks Spans and Joints numbered from South to North. Joint number and type: #1, 2, 3, 5, 6, 7, 10, 11, 12 - expansion; #4, 9 - construction; #8 - steel expansion.  
Concrete approaches.

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

Form 1011

Bridge No. S07 of 39024 Location I 94 (EB) over US 131 (SB)  
Date Measured 10-22-64 Number of Spans 3 Length (including approaches) 337.6  
Dual Structures (separate for each roadway) Yes  No   
Single Structure Yes  No  Method of Finishing Hand  
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.	
Span 1	32.4	71	63	107	77	80
2	70.2	74	104	102	106	96
3	35.0	87	95	107	68	89
4						
5						
6						
Weighted Average for Bridge		77	92	104	90	91
W Approach	100.0	104	105	104	116	107
E Approach	100.0	134	142	134	144	138
Weighted Average for Bridge and Approaches		102	111	113	113	110

         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.	
Span 1						
2						
3						
4						
5						
6						
Weighted Average for Bridge						
Approach						
Approach						
Weighted Average for Bridge and Approaches						

Remarks Spans and Joints numbered from West to East. Joint number and type: #1, 5, 8 - construction; #2, 3, 4, 6, 8, 9 - expansion; #7 - steel expansion. The acceleration and deceleration lanes were not run because of heavy traffic flow, cantilevered structure;

Concrete approaches.



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

Form 1011

Bridge No. S07 of 39024 Location I 94 WB over US 131 SB

Date Measured 1-11-65 Number of Spans 3 Length (including approaches) 337.6

Dual Structures (separate for each roadway) Yes  No

Single Structure Yes  No  Method of Finishing Hand

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.	
Span 1	32.5	74	89	119	92	94
2	69.6	75	67	49	48	60
3	35.5	25	6	90	65	46
4						
5						
6						
Weighted Average for Bridge		62	56	76	63	64
W Approach	100.0	98	96	101	114	102
E Approach	100.0	103	124	108	125	115
Weighted Average for Bridge and Approaches		85	88	93	96	90

         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.	
Span 1						
2						
3						
4						
5						
6						
Weighted Average for Bridge						
Approach						
Approach						
Weighted Average for Bridge and Approaches						

Remarks Spans and joints numbered from West to East. Joint number and type: #1, 2, 3, 5, 8 expansion; #4, 7 construction; #6 steel expansion

Concrete Approaches

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

Form 1011

Bridge No. S08 of 39024 Location I 94 (EB) over US 131 (WB)  
Date Measured 10-22-64 Number of Spans 3 Length (including approaches) 338.6  
Dual Structures (separate for each roadway) Yes  No   
Single Structure Yes  No  Method of Finishing Hand  
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.	
Span 1	32.4	91	73	53	85	76
2	70.2	96	94	72	76	84
3	36.0	83	73	97	102	89
4						
5						
6						
Weighted Average for Bridge		92	84	74	85	84
W Approach	100.0	106	116	115	148	121
E Approach	100.0	87	70	117	127	100
Weighted Average for Bridge and Approaches		94	89	99	116	100

         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.	
Span 1						
2						
3						
4						
5						
6						
Weighted Average for Bridge						
Approach						
Approach						
Weighted Average for Bridge and Approaches						

Remarks Spans and Joints numbered from West to East. Joint number and type: #1, 3, 6, 7, 8 - expansion; #2, 5, 9 - construction; #4 - steel expansion. The acceleration and deceleration lanes were not run due to heavy traffic flow. Cantilevered structure.

Concrete approaches.

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

Form 1011

Bridge No. S08 of 39024 Location I 94 WB over US 131 NB  
Date Measured 1-8-65 Number of Spans 3 Length (including approaches) 338.5  
Dual Structures (separate for each roadway) Yes  No   
Single Structure Yes  No  Method of Finishing Hand  
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.	
Span 1	33.2	72	87	117	90	92
2	69.8	75	67	49	48	60
3	35.5	25	06	90	65	46
4						
5						
6						
Weighted Average for Bridge		61	56	75	62	64
W Approach	100.0	103	124	108	125	115
E Approach	100.0	98	96	102	114	102
Weighted Average for Bridge and Approaches		85	88	93	96	90

         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.	
Span 1						
2						
3						
4						
5						
6						
Weighted Average for Bridge						
Approach						
Approach						
Weighted Average for Bridge and Approaches						

Remarks Spans and joints numbered from West to East.  
Joint number and type: #1, 3, 6, 7, 8 expansion; #2, 5, construction #4 steel expansion.  
Concrete approaches.

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

Form 1011

Bridge No. S24 of 41027 Location Maryland Ave. over I 96  
Date Measured 10-30-64 Number of Spans 4 Length (including approaches) 330.6  
Dual Structures (separate for each roadway) Yes  No   
Single Structure Yes  No  Method of Finishing Machine  
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.	
Span 1	32.3	171	138			154
2	71.5	122	125			124
3	71.5	103	107			105
4	55.3	98	114			106
5						
6						
Weighted Average for Bridge		117	118			118
N Approach	50.0	238	151			194
S Approach	50.0	174	107			140
Weighted Average for Bridge and Approaches		144	122			133

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.	
Span 1	32.3	134	144			139
2	71.5	128	121			124
3	71.5	121	116			118
4	55.3	161	126			144
5						
6						
Weighted Average for Bridge		135	124			130
N Approach	50.0	188	137			162
S Approach	50.0	167	136			152
Weighted Average for Bridge and Approaches		148	128			138

Remarks Spans and Joints numbered from South to North. Joint number and type: #1, 5 - construction; #2, 3, 4 - expansion.  
Bituminous approaches.

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

Form 1011

Bridge No. X01 of 41027 Location I 96 over GTWRR N. of Grand Rapids

Date Measured 10-29-64 Number of Spans 3 Length (including approaches) 4466

Dual Structures (separate for each roadway) Yes  No

Single Structure Yes  No  Method of Finishing Hand

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.	
Span 1	69.3	67	56	68	75	66
2	106.0	68	86	82	65	75
3	71.3	79	80	78	84	80
4						
5						
6						
Weighted Average for Bridge		71	76	77	73	74
W Approach	100.0	89	80	70	99	84
E Approach	100.0	89	80	70	99	84
Weighted Average for Bridge and Approaches		79	76	75	80	78

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.	
Span 1	69.3	117	74	77	53	80
2	106.0	100	81	97	136	104
3	71.3	56		75	112	81
4						
5						
6						
Weighted Average for Bridge		92	55	85	106	84
W Approach	100.0	81	69	95	87	83
E Approach	100.0	64		79	68	70
Weighted Average for Bridge and Approaches		83	46	86	93	77

Remarks Spans and joints numbered from West to East.  
Joint number and type: #1, 2, 4, 7, 8 expansion; #3, 6 construction; #5 steel expansion.

Contilevered structure

Concrete Approaches

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

Form 1011

Bridge No. S 15 of 41029 Location I 96 over Garfield and Valley Ave.

Date Measured 10-27-64 Number of Spans 4 Length (including approaches) 414.9

Dual Structures (separate for each roadway) Yes  No

Single Structure Yes  No  Method of Finishing Hand

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.	
Span 1	60.2	84	112	118	127	110
2	64.8	127	138	130	105	125
3	50.5	110	112	108	132	116
4	39.4	194	201	150	145	172
5						
6						
Weighted Average for Bridge		123	136	125	124	127
S Approach	100.0	96	106	79	112	98
N Approach	100.0	77	106	82	81	86
Weighted Average for Bridge and Approaches		106	122	104	111	111

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.	
Span 1	60.2	187	162	137	161	162
2	64.8	200	215	139	130	171
3	50.5	129	156	184	235	176
4	39.4	215	187	180	232	204
5						
6						
Weighted Average for Bridge		182	181	156	182	175
S Approach	100.0	97	91	107	123	104
N Approach	100.0	111	123	110	109	113
Weighted Average for Bridge and Approaches		144	145	133	150	143

Remarks Spans and joints numbered from South to North. Joint number and type: #1, 2, 4, 6, 8, 9, 10 expansion; #3, 7 construction; #5 steel expansion. Concrete Approaches.

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

Form 1011

Bridge No. X01 of 41029 Location I 96 EB over C&O RR  
 Date Measured 10-28-64 Number of Spans 5 Length (including approaches) 560.0  
 Dual Structures (separate for each roadway) Yes  No   
 Single Structure Yes  No  Method of Finishing Hand  
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.	
Span 1	62.0	127	167	149	165	152
2	67.5	139	148	156	183	156
3	63.5	181	163	117	157	154
4	85.0	153	149	157	144	151
5	82.0	110	132	161	162	141
6						
Weighted Average for Bridge		141	151	149	161	150
E Approach	100.0	71	100	79	72	80
W Approach	100.0	85	74	69	82	78
Weighted Average for Bridge and Approaches		118	128	122	130	124

         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.	
Span 1						
2						
3						
4						
5						
6						
Weighted Average for Bridge						
Approach						
Approach						
Weighted Average for Bridge and Approaches						

Remarks Spans and joints numbered from West to East.  
Joint number and type: #1, 2, 4, 5, 6, 7, 9, 10 expansion; # 3, 8 construction.  
Concrete approaches.

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

Bridge No. S34 of 82112 Location M 102 over I 696  
 Date Measured 11-17-64 Number of Spans 15 Length (including approaches) 1989.2\*\*  
 Dual Structures (separate for each roadway) Yes  No   
 Single Structure Yes  No  Method of Finishing Bid-Well Finishing Machine  
E Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile						Avg.
		Traffic Lane		Center Lane		Inner Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	O. W. P.	I. W. P.	
Span 1	90.4	85	116	73	85	120	114	99
2	91.3	68	57	69	81	64	67	68
3*	Variable	58	66	62	88	63	83	70
4	130.0	82	68	36	60	73	64	64
5	128.8	90	114	102	82	89	85	94
6	124.1	66	67	78	59	85	72	71
7	213.4	64	84	72	79	73	63	72
8	127.4	68	106	112	95	116	99	99
9*	Variable	137	179	118	121	114	124	132
10	130.6	48	56	54	59	48	59	54
11	130.8	126	114	115	85	119	129	115
12	130.8	102	75	69	60	61	69	73
13	140.0	132	115	112	123	132	119	122
14	107.5	68	70	99	75	98	95	84
15	105.6	138	146	147	98	184	144	143
Weighted Avg. for Bridge		86	93	86	82	94	90	88
Approach	100.0	126	118	74	73	94	84	95
Approach	50.0	106	71	79	38	53	83	72
Weighted Avg. for Bridge and Approaches		89	93	85	81	93	90	88

Remarks Spans and Joints numbered from West to East. Joint number and Type: #1, 3, 24, -  
Construction; #2, 6, 7, 12, 16, 20, 25, 26 - Expansion; #4, 5, 15, 19, 23 - Steel Expansion;  
#8, 11 - Steel finger; #9, 10, 13, 14, 17, 18, 21, 22 - Contraction. Concrete Approaches

\* Lengths of wheel paths vary; one end of span is at an angle.

\*\* Average lengths of spans 3 and 9 included.



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

Bridge No. S34 of 82112 Location M 102 over I 696  
 Date Measured 11-17-64 Number of Spans 15 Length (including approaches) 1989.2\*\*  
 Dual Structures (separate for each roadway) Yes  No   
 Single Structure Yes  No  Method of Finishing Bid-Well Finishing Machine  
W Bound Roadway

Item	Length	Profilometer Roughness Value - R inches per mile						Avg.
		Traffic Lane		Center Lane		Inner Lane		
		O. W. P.	I. W. P.	O. W. P.	I. W. P.	O. W. P.	I. W. P.	
Span 1	90.4	80	126	126	133	125	103	116
2	91.3	72	70	68	71	55	57	66
3*	Variable	146	146	113	131	86	82	117
4	130.0	51	86	64	72	92	74	73
5	128.8	90	85	82	84	101	125	94
6	124.1	34	78	76	67	69	70	66
7	213.4	50	51	62	70	53	64	58
8	127.4	51	59	68	68	64	50	60
9*	Variable	57	99	86	80	86	114	87
10	130.6	82	122	100	99	109	87	100
11	130.8	92	115	115	122	106	104	109
12	130.8	41	70	67	83	56	60	63
13	140.0	57	62	65	82	78	59	67
14	107.5	47	62	75	77	73	61	66
15	105.6	153	172	165	156	144	139	155
Weighted Avg. for Bridge		69	89	86	91	84	82	84
W Approach	100.0	74	87	38	72	98	76	74
E Approach	100.0	101	119	136	85	124	118	114
Weighted Avg. for Bridge and Approaches		71	90	86	90	87	83	84

Remarks \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

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

Form 1011

Bridge No. S 23 of 82251 Location EB I 94 Ramp to NB I 75  
 Date Measured 6-26-64 Number of Spans 4 Length (including approaches) 508.0  
 Dual Structures (separate for each roadway) Yes  No   
 Single Structure Yes  No  Method of Finishing Hand  
NB 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.	
Span 1	43.0	155				155
2	89.0	122				122
3	120.3	120				120
4	55.7	179				179
5						
6						
Weighted Average for Bridge		136				136
S Approach	100.0	219				219
B Approach	100.0	112				112
Weighted Average for Bridge and Approaches		148				148

NB 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.	
Span 1	44.0		194			194
2	91.0		110			110
3	129.7		97			97
4	52.0		194			194
5						
6						
Weighted Average for Bridge			130			130
S Approach	100.00		240			240
N Approach	100.00		122			122
Weighted Average for Bridge and Approaches			150			150

Remarks Spans and joints numbered from South to North. Joint number and type: #1, 5, 9 construction; #2, 3, 4, 6, 8, 10, 11 expansion; #7 steel expansion