State of Illinois
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
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EVALUATION OF THE CUTLER R-1000 REPAVER AND THE REPAVING PROCESS ON AN MFT MAINTENANCE RESURFACING PROJECT BY THE CITY OF WHEATON

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INTRODUCTION

In accordance with the Illinois Highway Development Council's recommendations for evaluating the Cutler R-1000 Repaver and the repaving process, the State of Illinois, during the 1966 construction season, participated in a maintenance resurfacing project by the City of Wheaton, which involved approximately 29,000 square yards of repaving.

The Development Council, on the basis of information received from the manufacturer of the Cutler machine and on the basis of the performance of repaving work done in the Chicago area by an earlier Cutler repaver, had recommended that favorable consideration be given to one request for MFT participation in a resurfacing project utilizing the Cutler R-1000 Repaver. The Council's recommendation included the proviso that the Bureau of Research and Development inspect the pavements to be repaved to ascertain that they had sound bases and were structurally adequate for anticipated traffic so that there would be good reason to believe that the desired results would be obtained.

The repaving work described by this investigation covers approximately 2.8 miles of a two-lane city street. An additional 3,000 square yards (0.2 miles) were resurfaced by conventional thin overlay procedures, and 10,000 square yards (0.6 miles) were left untreated.

LOCATION AND DESCRIPTION OF WORK

The location and extent of the test and control sections are shown in Table I and Figures 1 and 2.

TABLE 1

CUTLER R-1000 REPAVER TEST AND CONTROL SECTIONS

Map Code	Street	Location From	To	Length Ft.	Width Ft.	Area Sq. Yds.	Treatment
1	President St.	College Ave.	Prairie	3,045	30	10,150	No treatment
2	Harrison Ave.	Scott St.	Webster	2,813	30	9,367	Repaved
3	College Ave.	Blanchard and Hill Avenues	Pick St. and North Avenue	1,078	23	2,755	Repaved
4	Liberty Drive	Lorraine Rd.	Summit + 185 ft.	1,234	24	3,290	Repaved
5	Childs St.	465 ft. West of Delles	235 ft. East of Delles	700	23	1,788	Repaved
6	Ellis Ave.	Front St.	Lincoln Ave.	1,840	23	4,702	Repaved
7	Harrison Ave.	West St.	Scott St.	2,250	28	7,000	Repaved
8	Ellis Ave.	Gary Ave.	Madison	375	23	830	Thin overlay
9	Harrison Ave.	Ellis and Gary Ave.	West St.	925	28	2,320	Thin overlay
11	College Ave.	President St.	Blanchard Ave.	1,150	23	2,939	Repaved
12	College Ave.	Pick St.	Harrison Ave.	1,020	23	2,607	Repaved
13	College Ave.	Harrison Ave.	City Limit	1,100	30	3,667	Repaved

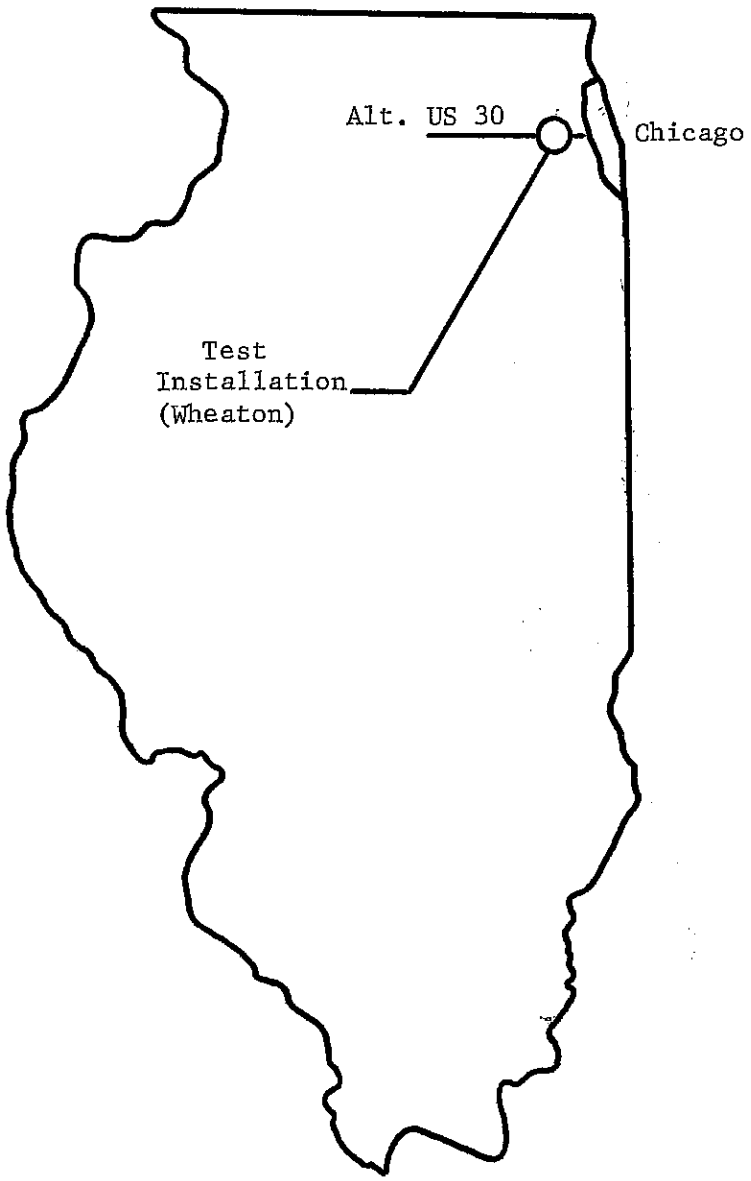

Figure 1. General location of test installation.

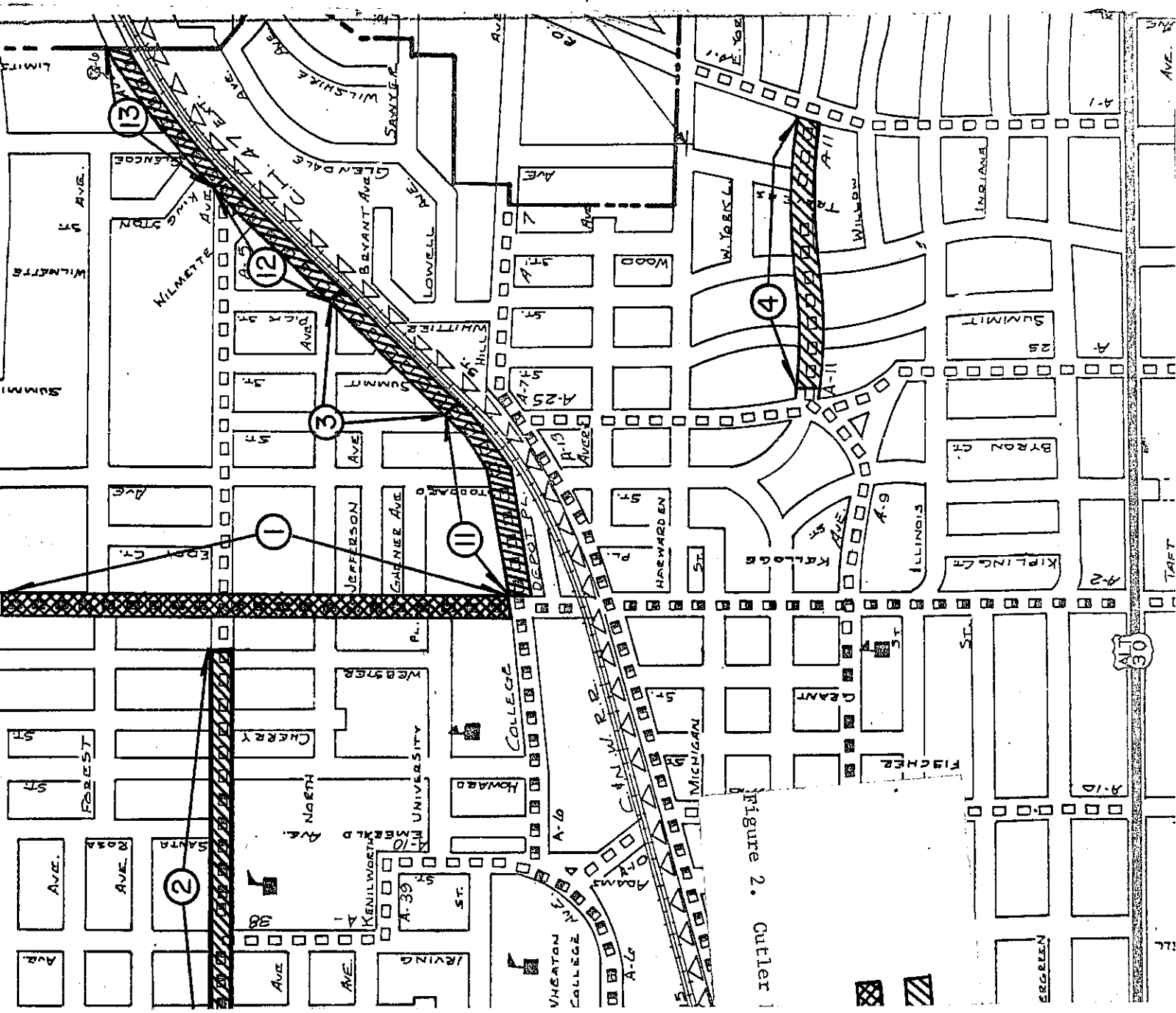

Figure 2. Cutler

The wearing course of each pavement included in this investigation was an accumulation of seal coats. As stipulated by the Development Council, the pavements were basically sound with only minor areas which required repair in depth before resurfacing. Although the existing surfaces were weathered, longitudinal and transverse reflection-type cracks were seldom closer than three feet and were generally more than eight feet apart. A few small areas of area cracking were found; however, they were exceptional and minor in nature. Prior to the construction work, detailed condition surveys and roughness measurements were made on all test and control sections.

The experimental resurfacing treatment, which was accomplished in a single pass of the repaver, consisted of the heating and reworking of the existing pavement to a depth of about one inch and the addition of an average of 83 pounds per square yard of modified B-5 dense graded aggregate-type bituminous concrete.

The control resurfacing consisted of approximately 123 pounds per square yard of the same modified B-5 mix placed by means of a conventional asphalt spreading and finishing machine directly on the existing surface, which had been primed with 0.10 gallon per square yard of RC-0.

DESCRIPTION OF MACHINE AND OPERATION

The Cutler Repaver combines the functions of a heater-planer with those of a finishing machine to heat, scarify, plane off, and respread the upper portion of a pavement; add a thin overlay of new hot mix; and compact both new and old material into a stratified (but integral) mat - all in a single pass. Before and after views are shown in Figure 3.

The Cutler R-1000 Repaver is a large machine with a 25-foot wheelbase and an eight-foot working width; however, since all four wheels are steerable, it is quite maneuverable. The heating is accomplished in two phases by two separate heater

Figure 3.
Before and after views of repaving on
Ellis Avenue at West Union Avenue.

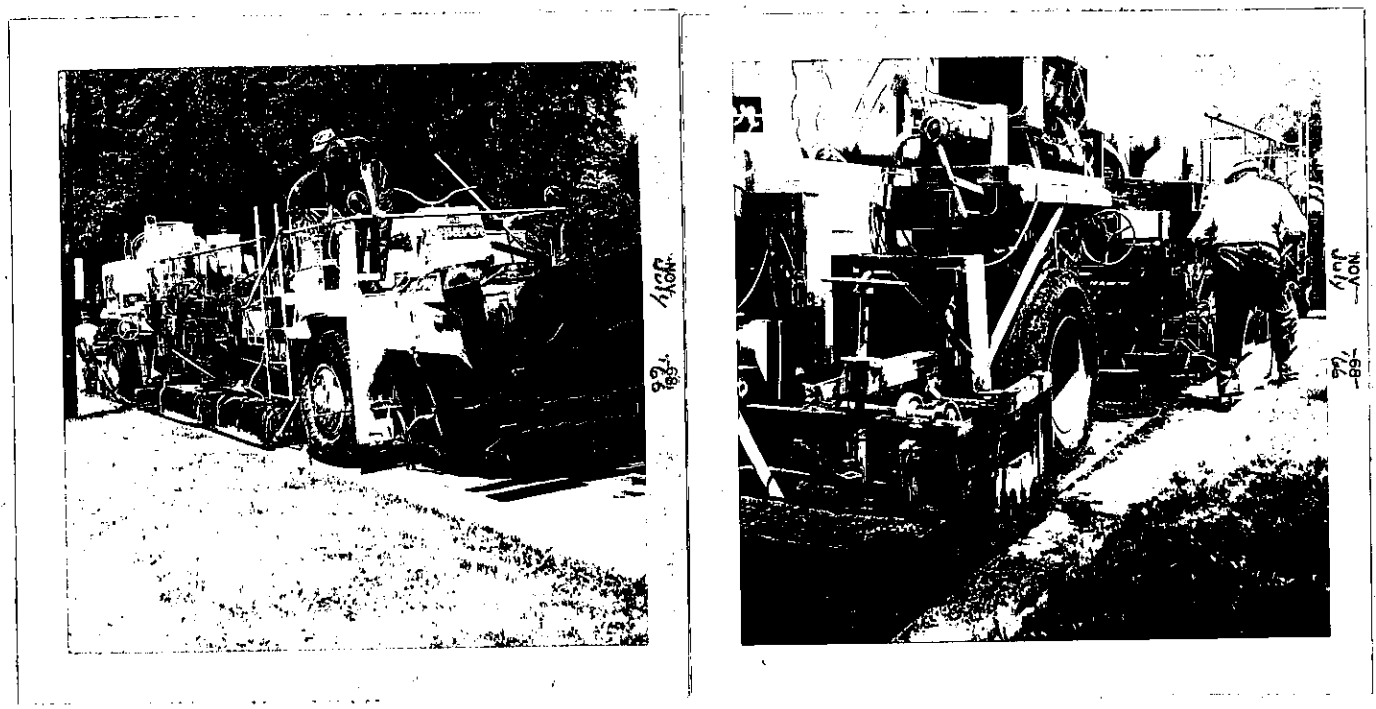

Figure 4.
Views of Cutler Repaver showing heating
hoods and ends of planer and screed.

hoods of six million Btu total capacity. The first heater hood raises the surface temperature to a minimum of 150° F for scarifying, and the second hood heats the scarified surface to a temperature of between 225° F and 425° F, as desired, depending upon the characteristics of the pavement. Following the second heating, a system of blades planes off and works the old material full width and spreads it over a seven-foot strip leaving a six-inch strip at each side to be paved entirely with a new mix for edges and longitudinal seams. Finally, the new material is deposited in a windrow, spread full width, and shaped and compacted along with the reworked material by a tamping screed. Figure 4 shows the ends of the heater hoods, planer blades, and screed. As in conventional paving, it is necessary to provide final compaction by rolling.

The Cutler machine requires three operators: (1) a front operator-driver; (2) a utility operator who controls the heaters, scarifier, planing and distributing blades, and new mix conveyor; and (3) a screed operator. Rounding out the crew on the Wheaton project were rakemen, a roller operator, and truck drivers. Although the manufacturer kept a man on the job to instruct and demonstrate the operation of the machine and to handle its maintenance and minor repairs, the crew consisted of regular city maintenance workers supplemented by student summer help.

It is claimed that under average conditions the machine can rework the existing pavement to an average depth of 1 1/4 inches while putting down an average of 75 pounds of new material per square yard at a sustained forward speed of from 15 to 20 feet per minute. On the Wheaton job the depth of reworked material, as determined from cores, appeared to vary from 1/2 to 1 1/4 inches. The amount of new material placed averaged approximately 83 pounds per square yard.

The sustained production claimed for the eight-foot-wide repaver, such as employed in Wheaton, is from 600 to 1,2000 square yards per hour depending upon

conditions. The production obtained on the Wheaton project would appear to bear out this claim. The best day's production was approximately 9,000 square yards in a nine-hour day.

The appearance of the newly repaved surfaces was similar to that which resulted when the same mix was placed by a conventional bituminous paver on the control sections except that the longitudinal joints tended to be more noticeable for the Cutler process. These longitudinal joints were much less noticeable where the work was done in short passes of three blocks or less in length so that each mat had less than an hour to cool before the overlaping pass was made.

At intersections and at other points of surface irregularities, such as ridging between ruts, the Cutler repaving process eliminated the high areas that tended to be scalped or pulled to an open texture by the conventional paver. With these exceptions, both the Cutler repaver and the conventional paver produced surfaces that have required no maintenance for the first 46 months.

Most of the more prominent cracks that were in the pavements before the reprocessing or overlaying in 1966 have reflected and tended to widen. The Wheaton Superintendent of Streets reports that they expect to do the first sealing of these cracks at the beginning of next winter (1970-1971) after more than 50 months of service.

The examination of cores taken 10 days after repaving revealed that the new mix was well bonded to the reclaimed material which in turn was well bonded to the scarified surface of the old pavement. The bonds between the layers were still excellent in cores which were taken 40 months after repaving. Figure 5 shows four cores taken soon after repaving and four cores taken 40 months later in the same areas. A slight blending appears to have occurred at each interface - probably because the reworked material was relatively uncompacted when the new

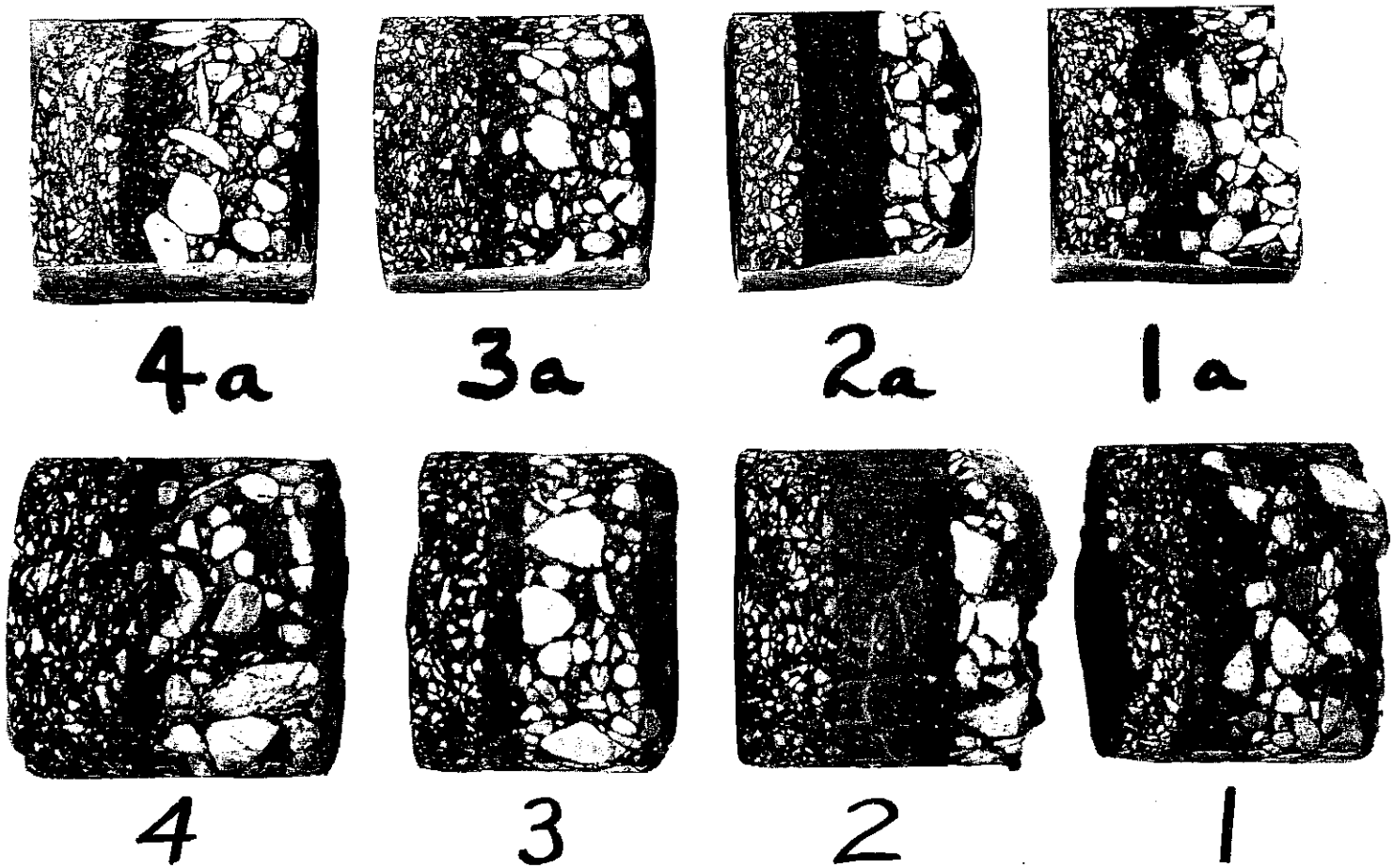

Figure 5.
Cores from 1966 MFT Maintenance in Wheaton
Cutler Repaver Experiment

Legend:

1.	Harrison Street	10 Days	After Construction
2.	Ellis Avenue	10 Days	After Construction
3.	Childs Street	10 Days	After Construction
4.	President Street	10 Days	After Construction
1a.	Harrison Street	40 Months	After Construction
2a.	Ellis Avenue	40 Months	After Construction
3a.	Childs Street	40 Months	After Construction
4a.	President Street	40 Months	After Construction

mix was spread over it. This procedure apparently aids the bonding by an interlocking of particles at the contacting surfaces.

Roadometer measurements made on the repaved sections indicate an improvement of approximately 100 inches per mile (down to approximately 140 from the average preconstruction reading of 240). Roughness measurements on the control section on Harrison Avenue changed similarly to the repaved sections. The roughness of the finished surface is high by rural mainline standards, but this can be attributed to the existence of numerous manholes and the crown of cross streets.

EVALUATION

This evaluation of the repaving process has depended primarily on periodic condition surveys and roughness measurements, which have provided a basis for performance comparison between the test and control sections. The frequency and extent of reflection cracking and other defects which will require maintenance have been found to be similar for the repaved and control sections.

The first costs plus maintenance costs when prorated per year of service life will permit a direct economic comparison for final evaluation. Currently, there appears to be an economic advantage for the Cutler repaving process when more than 1-inch average depth of new material is required to satisfactorily level and overlay surface irregularities by conventional paving procedures without preplaning. This construction cost advantage is in addition to the fringe benefits of saved gutter capacity and less inconvenience to traffic by the nature of the operation. No tack coat is required, which eliminates both the cost and car-spattering potential of this procedure as normally used with conventional overlays. Also, the costs and hazards of manhole adjustments are eliminated or substantially reduced.

Based on our investigation of the Cutler R-1000 Repaver to date, it can be concluded that the machine performs essentially as claimed by the manufacturer and that the appearance and performance of the repaving work are commendable and equal or exceed that of the control sections. The records of the City Engineer of Wheaton confirm our observations that no maintenance has been required during the first three and one-half years of service on either the test or control sections other than spot repairs associated with routine curb and gutter replacements. Areas of typical conditions and reflection cracking are shown in Figures 6, 7, and 8.

Figure 6 shows typical longitudinal reflection cracking on the repaved area of Harrison Avenue in the foregound, which is at the west end of Test Section 7. The conventional thin overlay begins at the far edge of the white painted crosswalk.

Figure 6.
Surface conditions at the transition from the repaved area (Section 7) to the control area (Section 9) at the crosswalk on Harrison Avenue, Wheaton, Illinois, as viewed westward at West Street.

Figure 7 shows the north end of the control area, Section 8, on Ellis Avenue to the intersection with Gary Avenue and Harrison Street where it meets the west end of Section 9 (control area). This portion of Test Section 8 has some scalped spots in the foreground that were evident immediately after the conventional thin overlay repaving. The repair areas adjacent to the gutters are the results of routine curb and gutter replacement.

Figure 7.
Control section surface conditions after two years of service at the north end of Ellis Avenue, Wheaton, Illinois.

Figure 8 shows a portion of Harrison Avenue east of the experimental repaved Section 2 where a single eight-foot-wide pass was made in 1966 to rework an area where repaving in 1965 without added material had left an open textured surface. This demonstrates how well a single pass can blend with the existing adjacent surface.

Figure 8.
Single pass repaving on Harrison Avenue at Summit Street.

A few meandering longitudinal cracks have reflected in the surface of all sections, but it appears that it may be 10 to 15 years before maintenance will be necessary other than an occasional crack sealing and eventually seal coating as is often required to extend the life of conventionally repaved streets.

The Cutler repaving process has the advantage of minimizing grade raise for the depth renewed, and it works satisfactorily over most existing manholes without adjustments. The loss of curb heights and gutter capacity is also less than for conventional additions of resurfacing materials.

Table 2 presents the available data from three series of Roughness Index determinations using Roadometer readings made prior to resurfacing, shortly after the repaving, and after 40 months of service, which cover four cycles of hot

seasons followed by cold seasons. The lengthening of the control sections during construction for more desirable lengths for Roadometer operations have resulted in some open spaces in the data table. However, numerous comparisons can now be made between pre-resurface roughness, post-construction, and the present. Strong improvements of 90 inches or more are indicated for both repaved and standard thin overlays.

The sections such as 6 and 8a, repaved and control respectively, which were the roughest originally, were improved the most but remained the roughest. There appears a fairly consistent ratio of one-half of the roughness removed. The post-construction and present readings are high compared to those from new or resurfaced rural, high-speed designed pavements. Much of this difference can be attributed to the crown of cross streets and numerous unadjusted manholes. Changes in the roughness of the repaved sections since construction are quite minor and probably statistically insignificant. The riding qualities and lack of required maintenance after four cycles of hot to cool seasons are commendable.

The long-term evaluation will require enough additional time for the service of one of the alternate procedures to demonstrate an economic advantage. The Wheaton investigation appears to be a sufficient trial to determine the feasibility of the Cutler repaving process for most urban conditions. Currently, the Cutler process appears to equal or exceed the performance of conventional thin overlays.

TABLE 2

CUTLER REPAVING - WHEATON, ILLINOIS

Series of Roughness Index Determinations
Pre-Resurfacing Run: July 18, 1966
New Construction Run: August 3, 1966
Three-Year Evaluation Run: November 1969

Experimental Section No.	Location	Length (miles)	Roughness Index (inches/mile) Pre-Resurfacing		New Construction (Raw RI)		Three-Year Evaluation	
	Harrison Avenue		EB	WB	EB	WB	EB	WB
9a (control)	Ellis Ave. to Gary Ct.	0.08	209	243	-	-	115	134
9b (control)	Gary Ct. to West St.	0.08	233	237	-	-	115	138
9 (9a+9b control)	Ellis Ave. to West St.	0.16	257	230	-	-	115	136
7	West St. to Scott St.	0.43	-	-	145	140	160	160
2	Scott St. to Webster St.	0.54	243	246	127	126	132	136
2a	Webster St. to College Ave.	0.54	256	243*	140	140	-	-
2+2a	Scott St. to College Ave.	1.08	230	237	133	132	-	-
	College Avenue		NEB	SWB	NEB	SWB	NEB	SWB
13	City Limit to Harrison Ave.	0.18	-	-	-	-	136	134
12	Harrison Ave. to Pick St.	0.17	-	-	150	128	117	115
3	Pick St. to Blanchard St.	0.22	-	-	171	146	155	144
11	Blanchard St. to President St.	0.22	-	-	-	-	133	115
3+11+12	Harrison Ave. to President St.	0.59	175	182	158	146	135	125
	President Street		NB	SB			NB	SB
1 (untreated)	College Ave. to Prairie Ave.	0.58	175	182			202	187
	Ellis Avenue		NB	SB	NB	SB	NB	SB
8 (control)	Madison Ave. to Harrison Ave.	0.07	304	280	-	-	114	110
8+8a (lengthened control)	Lincoln St. to Harrison Ave.	0.21	318*	300*	-	-	123	115
6	Front St. to Lincoln St.	0.34	324*	323*	-	-	134	124
6+8a	Front St. to Madison Ave.	0.48	325*	323*	184	184	133	122
6+8a+8	Front St. to Harrison Ave.	0.55	323	321	-	-	131	121

*Interpolated