FINAL REPORT

Evaluation of Reflective Crack Control Policy

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Project IA-H1, FY95/96

Report No. ITRC FR 95/96-4

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16. Abstract

The Illinois Department of Transportation (IDOT) spends two million dollars annually on reflective crack control treatments; however, their cost-effectiveness has never before been reliably determined. The study evaluated the cost-effectiveness of IDOT reflective crack control system "A", which consists of a non-woven, ploypropylene paving fabric, placed wither in strips longitudinally over lane-widening joints or over the entire pavement ("area" treatment).

Performance of fifty-two projects across Illinois was assessed through crack mapping and from distress and serviceability data in IDOT's Condition Rating Survey (CRS) database. Comparisions of measured reflective cracking in treated and control sections revealed that system "A" retards longitudinal reflective widening crack development, but does not significantly retard thransverse reflective cracking. However, both strip and area applications of these fabric treatments appeared to improve overall pavement serviceability, and were estimated to increase rehabilitation life spans by 1.1 and 3.6 years, respectiviely. Life-cycle cost analyses (LCCA) found strip and area reflective crack control treatments to be marginally cost effective, where a 4.5-percent reduction in life cycle costs was estimated, for medium-sized projects (between 1 and 6 miles of two-lane road). Samll projects (under 1 mile of two lane road) showed a breakeven level of cost-effectiveness, while larage projects (over 6 m iles of two-lane road) showed a 6.2-percent savings in life-cycle costs.

Permeability testing of field cores taken over transverse joints showed that waterproofing benefits can exist after reflective crack appearance, which explains why serviceability was improved with area treatment even though crack development was not retarded. Guidelines for establishing and monitoring future experimental sections were also developed.

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EVALUATION OF REFLECTIVE CRACK CONTROL POLICY

Final Report

Project IA-H1

of the

Illinois Transportation Research Center (ITRC)

By

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A Cooperative Investigation Conducted by the

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In Cooperation with the

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EXECUTIVE SUMMARY

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When an asphalt overlay is placed over an existing pavement, cracks or construction joints in the underlying pavement can eventually propagate reflective cracks to the surface of the new pavement, which can significantly reduce the life of the overlay. The Illinois Department of Transportation (IDOT) spends approximately two million dollars annually on reflective crack control treatments; however, the cost-effectiveness of these treatments has never been reliably determined. The objective of this study was to determine the cost-effectiveness of the various crack control methods currently used in Illinois.

The scope of the study was originally intended to cover all three of the currently allowed reflective crack control systems in Illinois (termed reflective crack control Systems A, B and C); however, it was found that two of the three Systems (B and C) were rarely used. As a result, the scope of the study was revised to focus on the cost-effectiveness of IDOT reflective crack control System A, which consists of a lightweight paving fabric. The fabric is sandwiched near the bottom of the new asphalt overlay layers and is intended to intercept the upwards propagation of reflective cracks. The treatments can be placed in 24-inch wide longitudinal strips (strip treatment) along lane widening joints and centerline joints (oriented in the direction of traffic), or as an area treatment, which involves the use of full lane-width rolls of paving fabric.

Surveys were sent to all nine IDOT districts to solicit projects for the study, particularly those with untreated portions, to serve as control sections. While over 140 projects were identified on district surveys, only eight included control sections. A subset of fifty-two projects were selected for detailed study, based upon balancing factors such as traffic, environment, project size, and overlay age. The performance of the projects selected for detailed study was assessed through crack mapping and by obtaining performance data from IDOT's Condition Rating Survey (CRS) database. Because of their great abundance in Illinois, the study was focussed on overlays placed on rigid bases, or Portland cement concrete roadways, usually covered with existing bituminous overlays.

Side-by-side comparisons of treated and control sections in the field revealed that IDOT reflective crack control System "A" appeared to retard longitudinal reflective widening joint cracks, but not transverse reflective cracks. However, both strip and area treatments were predicted to extend the useful lives of bituminous overlays. Control sections were predicted to have an average overlay life of 10.4 years, while strip- and area-treated projects were predicted to have average overlay lives of 11.5 and 14.0 years, respectively. Economic analyses were performed to assess the cost-effectiveness of the strip and area treatments. Strip and area

treatments were determined to be marginally cost effective, as life cycle cost savings ranged from approximately 6.2 percent for large projects (about six miles of two-lane highway) to little or no savings for small projects (under one mile of two-lane highway). However, due to the amount of data extrapolation required to make life span predictions, differences in life cycle costs of treated and untreated sections were found to be statistically insignificant. New experimental sections and performance assessment procedures developed in this study will reduce extrapolation and should strengthen predictions considerably in as little as two years.

Given the relative inexperience in Illinois regarding reflective crack control Systems B and C, their cost-effectiveness remains to be determined. Follow-up activities, as outlined in this study, will be needed to help fully realize benefits of the new experimental sections developed in this study.

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Chapter 1

Introduction

1.1 Overview

The Illinois Department of Transportation (IDOT) spends approximately two million dollars annually on reflective crack control treatments; however, the cost-effectiveness of these treatments has never been reliably determined. There also exist widespread differences in how these treatments are used to rehabilitate deteriorated pavements. For instance, some districts now routinely use area reflective crack control treatments over rigid pavements in an effort to control both transverse and longitudinal reflective cracking. Sometimes the crack control treatments are used in lieu of pavement patching. Thus, there is a clear need to determine the performance benefits of reflective crack control treatments currently allowed in Illinois, and to conduct economic analyses to assess their cost-effectiveness.

1.1.1 Reflective Cracking Mechanism

When an overlay is placed on existing pavement, physical tearing of the overlay takes place as a result of movement at the joints and cracks in the underlying pavement layer (Figure 1.1). Reflection cracking has occurred in nearly all types of overlays. When an asphalt concrete overlay is placed over an existing pavement surface, the former is fully bonded with the latter. Any movement taking place in the underlying pavement at its joint/crack will produce stresses in the overlay and can cause physical tearing if the stresses in the overlay exceed its tensile strength. There are three common modes of failure associated with joint/crack movements. These three movements at the crack interface are shown in Figure 1.2. Horizontal movement of the slab is the most common mode of reflection cracking. It is usually temperature associated and causes tensile stresses to develop in the overlay. Vertical movement is primarily load induced and leads to shear stresses in the overlay. Parallel movement is less common and occurs only under laterally unstable conditions.

Reflection cracking in the overlay allows water to percolate into the pavement structure and weaken the subbase and also contributes to many types of pavement deterioration, including increased roughness and spalling. Existing methods of overlay design have not addressed this problem well. A number of past studies have been conducted in an effort to minimize or delay the occurrence of reflection cracking (*references 1, 2, 3, 4, 5, 6, 7, 8, 9, 10*). Various techniques are commonly used, such as increasing the thickness of overlay, slab fracturing (crack/seat, break/seat, and rubblization), modification of asphalt properties, the use of crack arresting

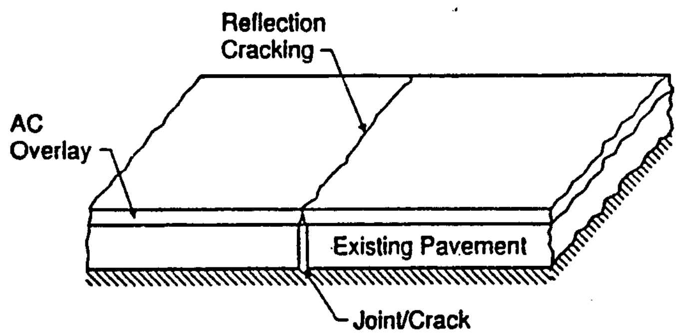


Figure 1.1. Reflection Cracking in Asphalt Overlays (After Mukhtar and Dempsey, *12*)

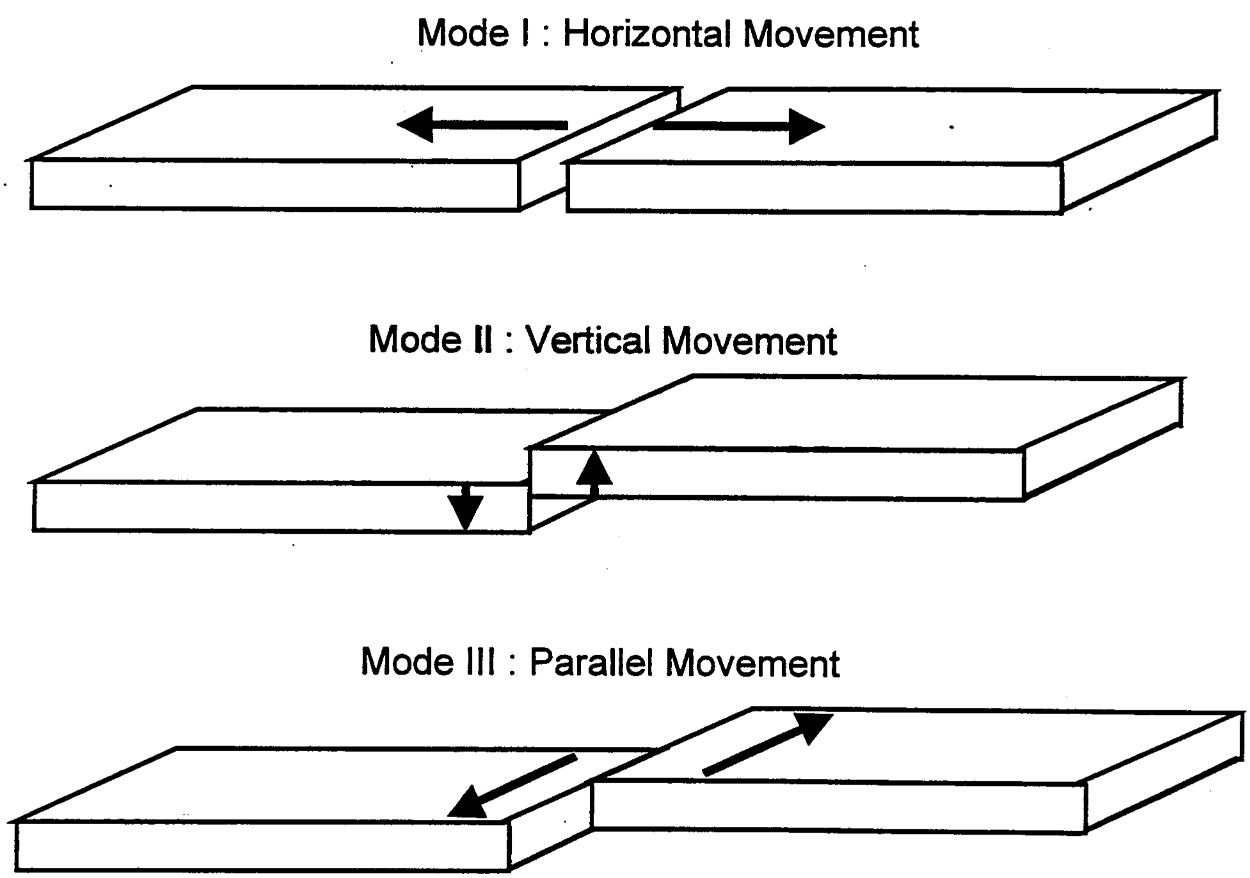


Figure 1.2. Movements in Underlying Pavement Layers That Contribute to Reflective Cracking (After Mukhtar and Dempsey, *12*)

interlayers (geotextiles) and stress absorbing membrane interlayers (SAMIs). Some of these techniques have shown positive results under certain conditions but many have given poor performance once subjected to the range of conditions existing in the field.

1.1.2 IDOT Reflective Crack Control Policy

The Illinois Department of Transportation has allowed the use of reflective crack control treatments for longitudinal cracks since the early 1980's. Current policy, described in IDOT design memorandum 95-16 (DM 95-16), allows a choice among three methods for controlling longitudinal cracking on projects involving resurfacing of rigid or flexible bases as follows:

1. System A. System A consists of nonwoven reinforcing fabric meeting the requirements of Article 1062.01 of IDOT's Standard Specifications for Road and Bridge Construction (*11*), placed on a hot applied asphalt cement binder over the prepared pavement surface.

2. System B. System B consists of a prefabricated waterproofing membrane interlayer with woven or nonwoven reinforcing fabric embedded in a layer of self-adhesive plasticized bitumen, and meeting the requirements of Article 1062.02 of the Standard Specifications. A primer that is compatible with the membrane should be applied on the prepared pavement surface prior to placing of the system.

3. System C. System C consists of nonproprietary asphalt-rubber waterproofing membrane interlayer and cover aggregate meeting the requirements of Article 1062.03 of the Standard Specifications, placed at a specified rate of application on the existing pavement surface.

Reflective crack control is classified as Area Reflective Crack Control Treatment and Strip Reflective Crack Control Treatment. Systems A, B, and C are used for strip applications and Systems A and C are recommended for area applications. The area method involves sealing joints and cracks, placing a leveling course of asphalt concrete, if needed, applying a tack coat, placing the engineering fabric, and overlaying with additional asphalt concrete lifts. Strip application using Systems A or C is recommended to be at least 24 inches (600 mm) wide. System B is recommended to be placed in strips at least 12 inches (300 mm) in width. Depending upon existing pavement profile, a leveling binder lift is usually required before placing strip reflective crack control treatment.

DM 95-16 also states that area reflective crack control treatment should be placed only on flexible bases. However, some IDOT districts have used area reflective crack control over deteriorated PCC pavements with bituminous overlays, on the basis that these pavement systems behave more like flexible pavements than rigid pavements. Thus, there is a clear need to better define rigid and flexible bases and to evaluate the use of area reflective crack control over rigid bases.

1.2 Problem Statement

The cost-effectiveness of currently allowed crack control treatments needs to be investigated thoroughly. Field tests have indicated that the use of currently specified treatments do retard the initial appearance of longitudinal reflective cracks, but the benefit of such a delay as compared to the cost of the treatment is not known. Because few projects using reflective crack control treatments are constructed under controlled study conditions, it is difficult to assess the cost-effectiveness of the various currently allowed systems.

1.3 Objectives of Study

The objective of this study is to determine the cost-effectiveness of the various reflective crack control treatments currently used in Illinois.

1.4 Project Tasks

The general objective of this study is to determine the cost-effectiveness of currently used reflective crack control treatments. Accomplishing this objective required the following tasks:

Task A: A review of the literature on field studies of reflective crack control test sites in Illinois and elsewhere was conducted to determine the state of the art (Chapter 3).

Task B: Illinois projects representative of each of the three allowed systems for longitudinal (strip) crack treatment were identified (Chapter 4). These projects were chosen in coordination with the Technical Review Panel (TRP) and considered the variables which impact the performance of the treatments in a given setting, such as:

1. Location of the test site, including district;
2. Identification of site parameters such as climate, drainage, and traffic mix;
3. Pavement cross-section and condition of the original pavement at time of treatment;
4. Specifics of initial treatment including date of initial treatment, thickness of overlay, location of reflective crack control treatment (on existing surface, on roto-milled surface, or on leveling binder), and brand, cost, and total quantity of reflective crack control treatment used;
5. Quantitative description of current cracking condition as a function of age of the treatment;
6. Any existing or currently scheduled repairs and the estimated costs, and;

7. Elapsed time from date of treatment to date of crack reappearance, if possible to determine.

The performance of these projects was assessed through district interviews and surveys, site visits, viewing Pavetech videos, and by querying the Department's Condition Rating Survey (CRS) Database, as presented in Chapter 5.

Task C: A number of projects were selected in coordination with the TRP that were eligible for strip crack treatment, but were constructed without such treatment (Chapter 4). The performance of these projects was also assessed as outlined in Task B (Chapter 5).

Task D: A number of projects were identified in coordination with the TRP that were constructed using area crack treatment. Projects were selected with rigid and flexible bases (Chapter 4). The performance of these projects was quantified and compared with similar projects that did not involve the use of area treatment (Chapter 4).

Task E: Interviews were conducted at the district level to determine the perceived performance benefit of each of the allowed crack control treatments, and of the experimental area treatment over rigid bases (Chapter 4).

Task F: Based upon performance data collected, the performance improvement associated with using reflective crack control treatments was assessed (Chapter 5). Cost effectiveness was then evaluated using life cycle costing techniques (Chapter 6). A limited study was performed to assess the waterproofing benefits of fabrics well after reflective cracks appear. This involved coring over severe reflective cracks at joints in the field and testing for leakage through the recovered core containing the membrane layer using a lab permeameter developed in the study (Chapter 7).

Task G: Monitoring procedures were developed for existing and future reflective crack control treatment projects to ensure that adequate data are collected to determine future cost effectiveness (Chapter 8). Furthermore, new controlled experiments were coordinated where control sections were built into several projects receiving reflective crack control treatments in 1997 and 1998. A set of guidelines for the layout and for materials sampling and testing was developed (Chapter 8).

Additional information concerning project tasks and the research approach used in this study is outlined in Chapter 2.

Chapter 2

Research Approach

2.1 Summary of Approach

Figure 2.1 presents a flowchart, illustrating the approach taken to accomplish the study objectives and tasks, as given in Chapter 1. A brief description of the various stages of research conducted is given below.

- **Literature review (Chapter 3)**: A comprehensive literature review was conducted to determine the state of the art with respect to reflective crack control methods and materials. Special emphasis was given to studies investigating the cost effectiveness of reflective crack control systems.
- **Project Identification Survey (Chapter 4)**: During the literature review stage, a survey was developed and sent to the nine IDOT districts, soliciting projects that involved the use of reflective crack control treatments. Districts were urged to identify projects containing control sections; that is, projects containing one or more segments without treatment.
- **Initial Screening of Projects (Chapter 4)**: Given the response to the first survey, criteria were established to filter out some of the smaller projects identified in the project identification survey before developing a more detailed follow-up survey.
- **Follow-up Survey (Chapter 4)**: A second survey was developed and distributed to the districts so that more detailed information concerning the most promising projects would be obtained.
- **Database Development (Chapter 4)**: A database was developed to facilitate the storage, analysis, and plotting of study data. Central to the efficiency of the database was the development and use of Visual Basic programs.
- **Experimental Design and Final Project Selection (Chapter 4)**: A final subset of projects was selected for detailed performance and economic analysis, based upon an experimental design that considered factors such as climate, traffic, and treatment method.
- **Performance Assessment (Chapter 5)**: Performance data was collected, plotted and analyzed. Different measures of overlay performance were compared, including crack mapping results, and IDOT's CRS system, which gives distress levels and overall serviceability ratings for primary and interstate routes in Illinois. Performance comparisons of strip, area, and control sections are presented.

- **Waterproofing Study (Chapter 7)**: A limited study was conducted to determine if waterproofing benefits are still realized after reflective cracks appear.
- **Cost-Effectiveness (Chapter 6)**: Using the inputs developed in Chapters 4, 5, and 6, life cycle costs were computed using a sensitivity analysis approach.
- **Experimental Sections and Future Monitoring (Chapter 8)**: Protocols for the layout, documentation, and monitoring of new experimental sections are detailed. Details concerning the five experimental sections designed and constructed during this study are also documented.
- **Conclusions and Recommendations (Chapter 9)**: Conclusions and recommendations for future monitoring and additional research are given.

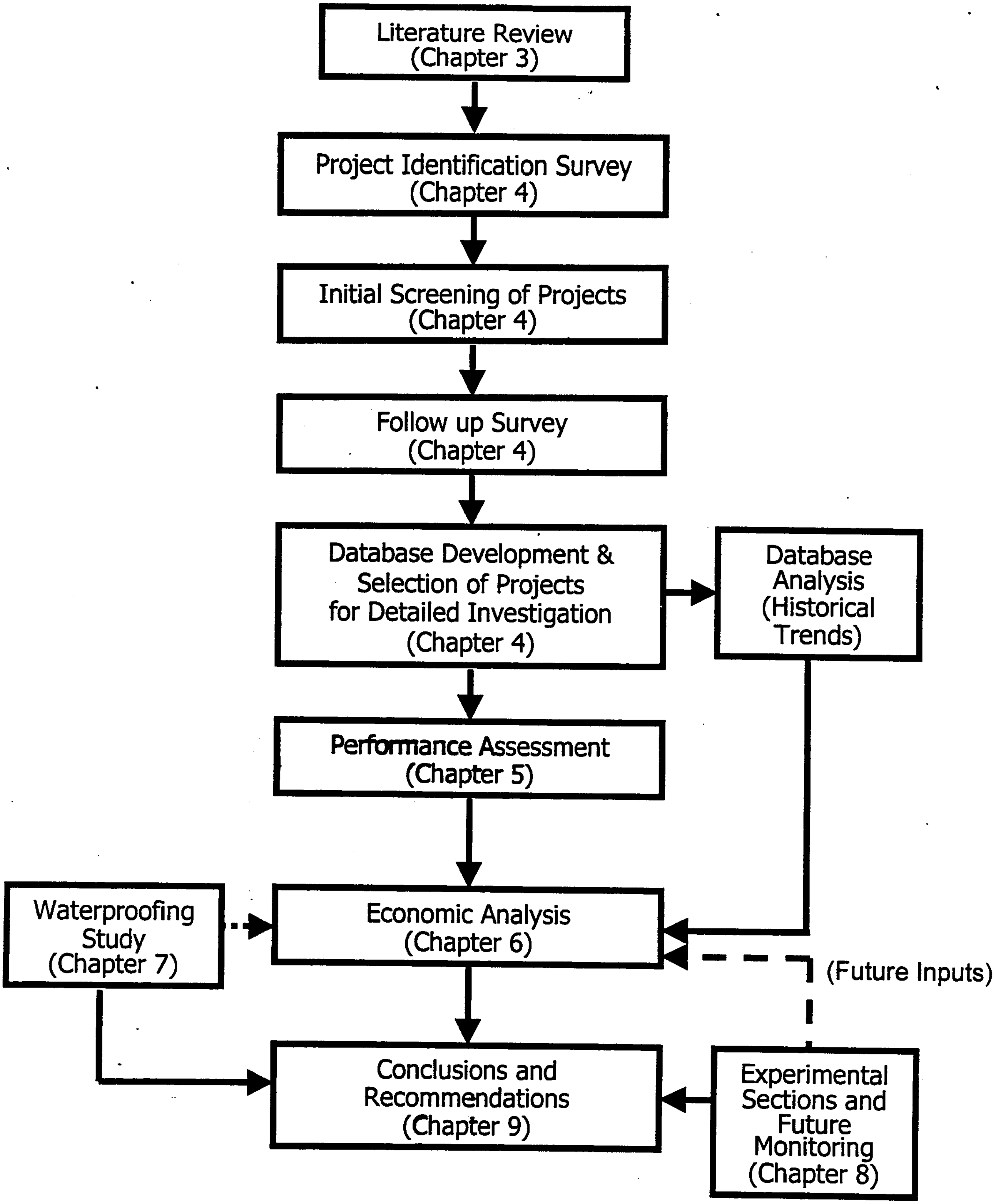


Figure 2.1. Research Approach

Chapter 3

Literature Review

3.1 Purpose of Literature Review

Geotextile interlayers (paving fabrics) are intended to reinforce asphaltic overlays by carrying tensile, and possibly shear stresses caused by environmental or traffic loadings. There have been many studies reported that involved the use of geotextiles to mitigate reflective cracking in asphaltic overlays. A broad literature review concerning the use of geotextile membranes as a barrier to reflective cracking was recently published under IDOT research project IHR-533 (*12*). The following literature review has therefore been focussed on providing background in the following three specific areas:

- Cost-Effectiveness of Reflective Crack Control Systems
- Performance of Fabrics Used in Previous Studies
- Important Issues Related to Fabric Laydown

3.2 Cost-Effectiveness of Reflective Crack Control Systems

There are very few references in the literature that directly address the cost effectiveness of reflective crack control treatments. The few that were identified have been summarized below.

Button (*1*) found that none of the paving fabrics used in a Texas study were superior to seal coats, other paving fabrics or control sections (no fabric), after nine years of field performance. In his study, Button compared nine different 0.25-mile (402-m) long test sections. Each test section was treated with a different type of non-woven polypropylene or polyester fabric. The geotextile weight ranged from 3 oz/yd^2 (0.103 kg/m^2) to 8 oz/yd^2 (0.274 kg/m^2). Four of the nine sections were treated by non-woven polypropylene, which corresponds to IDOT reflective crack control System "A". The benefits of geotextiles in the mitigation of reflective cracking was evaluated by Button, who reported that geotextiles delayed the appearance of reflective cracks for approximately two to three years. However, geotextiles were not found to be a cost-effective measure for treating reflection cracking based on data from the nine test sections. The basis of cost effectiveness evaluation was not mentioned in his study.

Maurer and Malasheskie (*13*) conducted a 44-month field survey in Pennsylvania, which compared six different treated test sections with control sections. Four different paving fabrics were used, along with one fiberized-asphalt, and one fiber-reinforced asphaltic concrete. The treatment types used in the analysis are presented in Table 3.1. All treatments were laid down in one location; however, a combination of rigid and flexible bases were present. Maurer and Malasheskie conducted three surveys, at: 8 months, 26 months, and 44 months after construction.

Table 3.1. Treatment Description (From Maurer and Malasheskie, *13*)

	Treatment Identify	Product Description & Application
(1)	Control	No treatment - 1-1/2" ID-2 Wearing Overlay Existing Pavement.
(2)	Reepav T-376 Fabric Interlayer	Nonwoven, spunbonded, heatbonded polyester; rolled and tacked on existing pavement with asphalt cement prior to 1-1/2" ID-2 Wearing Overlay.
(3)	Amopave Fabric Interlayer	Nonwoven, needle punched, polypropylene; rolled and tacked on existing pavement with asphalt cement prior to 1-1/2" ID-2 Wearing Overlay.
(4)	Trevira 1115 Fabric Interlayer	Nonwoven, spunbonded, needle punched polyester; rolled and tacked on existing pavement with asphalt cement prior to 1-1/2" ID-2 Wearing Overlay.
(5)	Mirafi Fabric Interlayer	Nonwoven, needle punched, some heatbonding, polypropylene; rolled and tacked on existing pavement with asphalt cement prior to 1-1/2" ID-2 Wearing Overlay.
(6)	Fiber Pave 3010 Fiber-Reinforced Asphalt Interlayer	Asphalt cement (AC-20) composed of min. of 6% fine denier, short length polypropylene fiber; cast in place with specially designed mixing kettle/applicator prior to 1-1/2" ID-2 Wearing Overlay.
(7)	Bonifibers B Fiber-Reinforced Asphalt Overlay	Addition of 0.3% (by wt. of mix) fine denier, short length polyester fiber to ID-2 wearing at mixing plant; 1-1/2" Modified ID-2 Wearing Overlay of existing pavement.

Maurer and Malasheskie used a 10-year analysis period for life cycle cost analyses, and proposed several estimates of total future reflective cracking, as presented in Table 3.2. Fabric costs were taken as \$1.50 to \$2/yd^2 (\$1.79 to \$2.39/m^2), and sealing cost at \$0.29/ft (\$0.95/m). The estimates of life-cycle costs are presented in Table 3.2. Based upon their analysis, none of the fabrics treatments considered were found to be cost-effective.

Wright and Guild (*14*) presented a requisite lifetime increase (RLI) approach to assess the performance benefits of reflective crack control systems when reliable, long-term performance data are not available. This method is essentially a break-even analysis, where the number of years of lifetime increase required to offset initial costs of reflective crack control systems is computed and compared with existing performance data. Combined with engineering judgement, this method can be used to estimate whether or not a given reflective crack control system is cost-effective and justified.

Obviously, there is a lack of research results published to date for which a comprehensive assessment of the cost effectiveness of reflective crack control treatments has been considered. Thus, the research conducted in this study appears to be very timely.

3.3 Performance of Fabrics Used in Previous Studies

Table 3.3 summarizes the performance of reflective crack control treatments as reported by a number of investigators (from references *1, 5, 13, 15, 16, 17, 18*). Performance benefits were found to vary from little to no observed reflective crack delay in some projects, to a delay in crack reappearance of about three years. In general, the use of paving fabrics over conventional flexible pavements appeared to result in the most consistent performance benefit. When placed over rigid pavements, these studies indicated that reflective cracking normally occurred very rapidly despite the presence of the interlayer fabric. This is not unexpected, since high tensile and shearing stresses can occur in the asphaltic overlays of these systems, due to climatic- and traffic-related loads, respectively.

3.4 Important Issues Related to Fabric Laydown

3.4.1 Climate

Climate is one of the most important effects that influence the performance of paving fabrics. Tyner et al. (*19*) determined that paving fabrics had the highest probability of successfully retarding reflective cracking in warmer and more temperate climates (Figure 3.1). Notice that all three of the climatic zones developed for the United States cut through Illinois, which spans approximately 400 miles from north to south. This indicates that one must be very careful to consider climatic differences when assessing the performance of reflective crack control treatments in Illinois. For instance, a specific reflective crack control system that is found to perform satisfactorily in southern Illinois could show unsatisfactory performance in northern Illinois.

Table 3.2. Estimate of Life – Cycle Costs (From Maurer and Malasheskie, *13*)

Treatment Designation	Current Cracks (LF)	Prop. Seal Cost ($) ($.25/LF)	Const. Treatment Cost ($)	Prop. Total Cost ($) @ 44 Mo. After Const.	Estimated Cracks (Total) (LF) 80 Mo. After Const. 1 Method A	2 Method B	3 Method C	Estimated Costs ($) Seal & Reseal @ 80 Mo. (Assume Cost Escalates @ 5% Annually, ($0.29/LF) Method A	Method B	Method C	** Total Life Cycle Costs Based on Estimates ($) Method A	Method B	Method C
(1)	2,742*	686	---	686	4,987	4,248	3,866	1,466	1,232	1,121	2,132	1,918	1,807
(2)	2,134	534	5,280	5,814	3,880	3,304	3,007	1,125	958	872	6,939	6,772	6,686
(3)	1,586	396	4,800	5,196	2,882	2,454	2,234	836	712	648	6,032	5,908	5,844
(4)	1,298	324	5,440	5,764	2,360	2,010	1,829	684	583	530	6,449	6,347	6,295
(5)	1,508	377	4,640	5,017	2,739	2,323	2,124	794	674	616	5,811	5,691	5,633
(6)	1,471	368	6,400	6,768	2,677	2,279	2,074	776	661	601	7,544	7,429	7,369
(7)	1,348*	337	3,285	3,622	2,450	2,086	1,899	710	605	551	4,332	4,227	4,173

1 - Cracking will continue at 100% of the current 44 month weighted average rate LF/Mo.

2 - Cracking will continue at 67% of the current 44 month weighted average rate LF/Mo.

3 - Cracking will continue at 50% of the current 44 month weighted average rate LF/Mo.

* - Adjusted to equivalent area of other treatments (28,000 SF)

** - Assume 10 year life cycle and this is last maintenance to be performed

Table 3.3. Summary of Field Performance of Paving Fabrics to Retard Reflective Cracking

Study	Year of Const.	Year of Study	Base Type	System Type	Performance Benefit / Estimated Relative Life Increase	Location
Button (*1*)♦	1979	1989	ACP	Bidim C-22, Bidim C-34, Old Petromat, New Petromat, Petromat-8oz.	Fabrics delayed reflection cracking 2 to 3 years	West of Ozozna, TX
	1979		ACP	Bidim C-22, Bidim C-34, Old Petromat, New Petromat, Petromat 8oz.		West of Amarillo, TX
	1980		ACP	Bidim C-22, Bidim C-34, Old Petromat, New Petromat, Petromat-8oz. Bidim C-28		Edinburg, TX
	1981		CRCP	Old Petromat, New Petromat, Reepav-3oz. Reepav-4oz. Crown-Zellerbach Mirafi 900x		East of Tyler, TX

♦ Each location had a separate control section.

Table 3.3. (Continued) Summary of Field Performance of Paving Fabrics to Retard Reflective Cracking

Study	Year of Const.	Year of Study	Base Type	System Type	Performance Benefit / Estimated Relative Life Increase	Location
Dykes (*15*) *	1976	1980	ACP	Nonwoven Polypropylene	Fabric delayed alligator cracking more than 2 years	South California
	1977		ACP	Glass and Nonwoven Polypropylene	Fabric delayed alligator and longitudinal cracking about 2 years	Virginia
	1977		PCC	Petromat, Cerex, and Structofors	After 5 years 22, 26, 28, and 45 percent of cracks reflected through Petromat, Cerex, Structofors, and control respectively	Iowa
Hughes (*16*)	1971	1977	ACP	Petromat	After six years, no longitudinal cracks in treated section, control section did experience cracking	East of Harrisburg, VA
				Petromat	After six years, there were more cracks in control section than treated section.	Chatham Bypass, VA
				Petromat	After six years, neither treated section nor control section showed any distresses	South of Fancy Hill, VA
	1972		ACP	Petromat	After five years, both control and treated sections showed significant cracking	North Charlottesville NBL, VA

* Information was obtained from Appendix A of reference (*18*)

Table 3.3. (Continued) Summary of Field Performance of Paving Fabrics to Retard Reflective Cracking

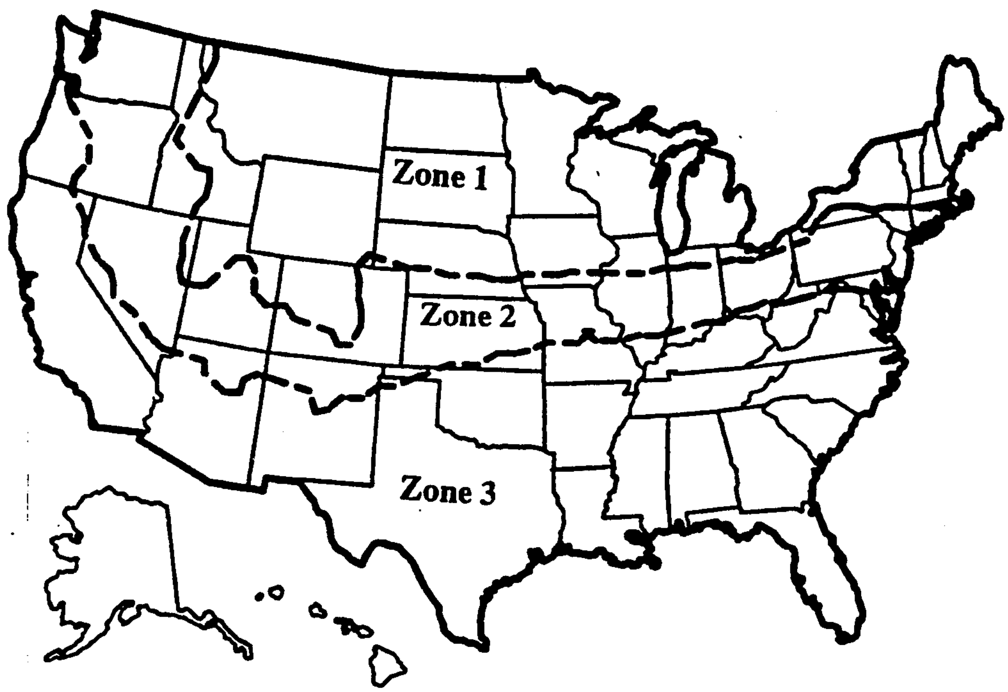
Study	Year of Const.	Year of Study	Base Type	System Type	Performance Benefit / Estimated Relative Life Increase	Location
Hughes (*16*)	1973	1977	ACP	Petromat and Burlington glass fabric	After five years, petromat showed a slight amount of longitudinal cracking. On the contrary, the control section showed alligator cracking and pumping.	North Charlottesville SBL, VA
	1976		ACP	Petromat and Mirafi	After one year, treated and control sections showed cracking.	Gloucester County, VA
Knight (*17*)	1981	1985	PCC	Polyguard, PavePrep, Bituthene, Roadglass, Petrotac, and Ryston 108 and 10 AR	Twenty- percent reduction in reflection cracking for treated areas versus untreated areas. PavePrep, Petrotac, and Roadglass performed significantly better than the other fabrics.	South East Pennsylvania
Mascunana (*18*)	1975	1981	ACP	Petromat	After 2 years, test section was better than control section in terms of crack number and width.	Cottage Grove Road, Urbana, IL
	1977		9-6-9 PCCP	Petromat	After almost 3 years, control was better than test section.	7th Street in Moline, IL
	1977		PCCP	Petromat	After one year, reflection cracking occurred for test and control section.	St. Charles Rd. in Elmhurst, IL

Table 3.3. (Continued). Summary of Field Performance of Paving Fabrics to Retard Reflective Cracking

Study	Year of Const.	Year of Study	Base Type	System Type	Performance Benefit / Estimated Relative Life Increase	Location
Mascunana (*18*)	1978	1981	ACP/ POZ Base	Petromat	After almost 2 years, test section had two minor cracks.	Prince Charles Lane and Prince Charles Court in Schaumburg
	1977		ACP/ CAM Base	Petromat	Runway pavement experienced cracking after 9 months.	Beardstown Airport in Beardstown, IL
	1978		CRCP	Petromat	After 2 years, test section was good. Existing CRC pavement was good without vertical deflections.	I 80 just East of Exit 1, IL 84
	1978		18 ft. PCCP widen ed to 22 ft. PCCP	Petromat, Mirafi 140, Heavy Duty Bituthene, and Asphalt Rubber Mixture	All treatments were effective in controlling reflective widening cracking. Control section showed longitudinal reflective cracking in one year. Mascunana observed that transverse cracks were difficult to control over rigid bases. Heavy Duty Bituthene even could not prevent reflection of transverse cracks.	IL 48 from IL 10 near Weldon to IL 54 near Fullerton
	1978		PCCP	Petromat	After 10 months, reflection cracks appeared	Douglas Street in Freeport

Table 3.3. (Continued). Summary of Field Performance of Paving Fabrics to Retard Reflective Cracking

Study	Year of Const.	Year of Study	Base Type	System Type	Performance Benefit / Estimated Relative Life Increase	Location
Mascunana (*18*)	1978	1981	CRCP	Petromat	Cracks reflected through in less than one year. There was no difference in the amount and severity of reflective cracking between test and control sections.	Northbound I 57 North and South of Dorans overpass bridge, Coles County
Maurer (*13*)	1984	1989	ACP With PCCP widening both sides	Reepav, Amopave, Trevira, Mirafi Fabric Interlayer, Fiber Pave 3010, and Bonifibers B	Based on the cracking after 44 months, crack sealing, and construction costs, none of the treatments were found to be cost-effective.	US 11 in the Borough of Wyoming, Luzerne County, Pennsylvania
McGhee (*5*)	1972	1975	PCCP	Unwoven Polypropylene	After three months under traffic, many of the cracks reflected through new overlay.	Route 460, Sussex County, VA
	1972		PCC Base	Petromat, and Chemstrand	Both fabrics delayed reflection cracking for some time. Petromat showed better performance than Chemstrand.	I 95 in Northern VA



Zone 1—Least favorable area for use of geotextiles
Zone 2—Less favorable area for use of geotextiles
Zone 3—Most favorable area for use of geotextiles

Figure 3.1. Climatic Zones and Expected Benefit of Reflective Crack Control Treatments (After Tyner et al., *19*)

In cold climates, pavements tend to contract, causing thermal openings in rigid pavement slabs at joints and cracks. When horizontal joint movements are less than 0.03 inches (0.76 mm), Lytton (*4*) determined that reflective crack control is not required. This condition would occur, for instance, in the case of a continuously reinforced concrete pavement with closely-spaced, tight cracks. For horizontal joint movements in the range of 0.03 inches (0.76 mm) to 0.07 inches (1.78 mm), paving fabrics will potentially reduce reflective cracking, according to Lytton. For horizontal movements larger than 0.07 inches (1.78 mm), or when vertical movements are present, fabrics are not effective in preventing reflection cracks from occurring. The latter conditions are akin to most of the rigid pavements in Illinois' state road system, many of which are approaching or have exceeded their design lives. Paving fabrics placed over these pavements should therefore not be expected to reduce the appearance of reflective cracking. However, other benefits, such as waterproofing, might prevail after reflective crack appearance. Thus, it is necessary to monitor the performance and to determine the life-cycle costs of these systems to evaluate their true benefits.

3.4.2 Pre-construction Treatment

Paving fabrics have been found to be more effective in retarding reflective cracks if the Load Transfer Efficiency (LTE) at PCC joints is larger than 0.8 (*4*). The Load Transfer Efficiency is the ratio of the vertical deflection on the unloaded side of the joint to the deflection on the loaded side. Although it is not practical to measure LTE as part of most rehabilitation projects, the repair of failed joints, working cracks, and pumping patches will extend the life of asphaltic overlays placed over rigid bases.

3.4.3 Tack Coat Application

Applying a proper tack coat is a key issue during the installation of paving fabrics. The tack coat should be applied uniformly and at a rate that will make the fabric impervious to water. Also, a proper tack coat is essential for adhering the paving fabric to the underlying pavement (*1, 5, 13, 20, 21*). If there is insufficient asphalt tack coat between existing pavement and fabric, the fabric can slip under high shear forces during hot weather. However, an excessive amount of tack coat can result in migration of the tack coat to the pavement surface (bleeding). Tack coat rates are defined differently for the three reflective crack control systems used in Illinois (e.g., Systems A, B, and C). For instance, System A specifes a uniformly sprayed asphalt binder, at a rate of 0.25 to 0.3 gal. per sq. yd. (1 to 1.3 L/m^2) (*11*). Accurate application of tack coat at these rates will minimize the aforementioned problems.

3.4.4 Fabric Properties

Chelliah (*20*) suggested that the paving fabric selected should be both durable and resilient to carry the stresses associated with reflective cracking. Stiffer fabrics have more resistance to wrinkling. Thicker or heavier fabrics resist wrinkling better than thinner or lighter fabrics. Flexible fabrics, however, can be placed more easily, with minimal wrinkles, especially around bends. An overly-stiff fabric will likely reflect irregularities of the existing pavement to the upper overlay (*21*). In general, the non-woven, polypropylene paving fabrics used on most projects in Illinois have good constructability, and can be laid down very rapidly.

3.4.5 Construction

A number of construction-related issues were found in the literature relating to reflective crack control systems. Button (*1*) found that fibers were abraded from fabrics if traffic was allowed to run on the fabric prior to placement of the bituminous overlay. Non-heat bonded fabrics were the most susceptible to this problem. Traffic was also found to lead to slippage, wrinkling, and tearing of fabrics, especially at intersections where turning, braking, and acceleration forces are highest. However, some engineers in Illinois believe that loads are beneficial in seating the fabric, thus helping the fabric adhere to the underlying pavement. Button (*1*) stated that pneumatic rolling of the fabric, followed soon thereafter with the placement of the bituminous overlay, represents the optimal laydown procedure. This allows for fabric seating, while avoiding traffic-induced fabric damage and loss of adhesion from moisture or an unclean fabric surface. When the fabric is placed shortly after a summer shower, water can be sealed in any unsealed cracks. Vaporization of the water can lead to the development of blisters and loss of adhesion.

Additional tack coat is required when fabrics are overlapped at joints to minimize disruption by wind and construction equipment (*1*). Fabric should be laid down smoothly with minimum wrinkling (*13*). If wrinkles result, they should be cut and overlapped to lay flat, as specified in IDOT's Standard Specifications for Road and Bridge Construction (*11*). Surface temperature of mix should not exceed 320 F (160 C), otherwise the paving fabric could shrink and wrinkle, according to Chelliah (*20*). This can be a concern when polymer-modified asphalt concrete mixtures are used, which sometimes are plant-mixed at temperatures exceeding this level. On reflective crack control projects involving polymer-modified mixtures, it will be important to carefully select a paving fabric and/or polymerized asphalt that will have amenable temperature compatibility at laydown.

3.4.6 Overlay Thickness

Chelliah (*20*) recommends a minimum overlay thickness of 2.0 inches (51 mm) when geotextiles are used to prevent reflective cracking over rigid bases. Button (*1*) recommends a minimum overlay thickness of 1.5 inches (38.1 mm) when geotextiles are used to prevent reflective cracking over flexible bases, particularly on high volume roads. Thinner overlays can break up, or scab, especially when there is poor bonding between the fabric and overlay. Thinner overlays are also more difficult to compact, thereby having increased permeability and the probability for adhesion loss due to prolonged exposure to moisture.

Chapter 4

District Surveys and Database Development

4.1 Overview

This chapter summarizes the development of district surveys and a spreadsheet-based database to collect and store information used to investigate reflective crack control cost-effectiveness. As a preliminary step, project identification surveys were developed and sent to the nine IDOT districts. Districts were urged to identify projects containing control sections; that is, projects containing one or more segments without treatment. Given the response to the first survey, criteria were established to filter out some of the smaller projects identified in the project identification survey before developing a more detailed follow-up survey. The criteria used to screen and select projects are detailed in this chapter.

A second survey was developed and distributed to the districts so that more detailed information concerning the most promising projects would be obtained. By the time the follow-up surveys began to return, a comprehensive database was developed to store, analyze and plot study data. Based upon the results of the district surveys, the scope of the study had to be slightly narrowed, as described later in this chapter. Finally, this chapter presents statewide trends derived from the database concerning usage and cost of reflective crack control treatments.

4.2 First Survey

A survey was developed in the early stages of the research project to identify any possible treated projects and control sections. In the first survey, districts were asked to identify projects receiving strip and area treatments, and possible control sections. The first survey solicited the following information for each project identified:

- Contract number
- Method of treatment (System A, B, or C)
- Type of treatment (area or strip)
- Placed over rigid or flexible base
- Brief job description
- Quantity of treatment
- Completion date
- Any untreated portion(s) of project to serve as control sections
- Brief descriptions of control sections if applicable

Over 200 projects were identified by the districts, as tabulated in Appendix A. Of these projects, very few were identified that utilized reflective crack control System B or C (ten were identified with System B and five with System C). Thus, about 93 percent of projects identified by the districts received reflective crack control System A. Therefore, System A necessarily became the sole treatment method investigated in the research.

Before soliciting more detailed project information, an initial screening of projects was performed to eliminate very small projects (less than one-half mile). This was done to help reduce the amount of information required from each district in a follow-up survey to a more reasonable level. The fabric quantities associated with the half-mile cutoff were 7,920 ft (2,414 meters) for strip treatment and 7,040 yd^2 (5,850 $meters^2$) for area treatment. For example, when strip treatment is used over the centerline joint and widening joints on both sides of the pavement, the total length of fabric used over a 0.5-mile (0.8-km) section will be 7,920 ft, 3*0.5*5280 = 7,920 ft (2,414 meters). Likewise, if area treatment is used over entire width of the road, the total quantity used for 0.5 mile (0.8 km) will be 7,040 yd^2. This is based upon two, 12-ft (3.7 meter) lanes, thus, (24/3)*(0.5)*(5280/3) = 7,040 yd^2 (5,850 $meters^2$).

After this initial screening was completed, 119 strip and 40 area treated jobs remained. These projects are summarized in the following section and in Appendices B and C.

4.3 Follow-Up Survey

For projects remaining after the preliminary screening, a second survey, the results of which are shown in Appendixes B and C, was developed and distributed to the districts to obtain detailed information about each project. District personnel were asked to check the existing data (from the preliminary survey) and to supply additional information, including the following:

- Road Information
- Traffic: All Following Traffic Information Needed To Calculate TF (Traffic Factor).
- ADT
- Average Daily Heavy Commercial Traffic
- Average Daily Multiple - Unit Traffic
- Number of Lanes
- Width of Strip Treatment (Only Asked For Strip Treated Jobs)
- Brand Name For Strip Treatment (If Applied)
- Unit Price Of Crack Control Material ($/ft For Strip Treatment, $/yd For Area Treatment)
- Maintenance and Rehabilitation
- Thickness Of Overlay Lift(s)
- Position of Crack Control Treatment
- AC Grade Used In Overlay Mixture
- Type, Condition, And Preparation of Existing Pavement Prior to Treatment
- Crack Sealing Since Overlay
- Subsequent AC Overlay
- Other Maintenance or Rehabilitation

- Performance:
    - Transverse Cracking
    - Longitudinal Cracking
    - Reflective Widening Crack
- Miscellaneous Information

4.3.1 Rigid Versus Flexible Bases

After reviewing the first surveys received from the districts, it became apparent that the definition of rigid and flexible base was ill-defined. Many PCC pavements with bituminous overlays were reported as flexible bases by survey respondents. In phone interviews, the respondents explained that since the concrete pavements were fifty years or older in some cases, and that many times when cores were obtained from these sections only rubble would be retrieved from the core barrel. Thus, the bases were judged as being flexible. However, field visits indicated that even older PCC bases had concentrated vertical movements at joints and cracks that usually resulted in the propagation of reflective cracks. Thus, any project having PCC pavement in the cross-section was categorized as having a rigid base for the purposes of this study, regardless of PCC age or cumulative thickness of subsequent bituminous lifts.

4.3.2 Elimination of Patching

District surveys and subsequent follow-up interviews indicated that some districts have been experimenting with reducing or eliminating patching prior to the placement of a bituminous overlay when area-wide reflective crack control treatment is used. The savings in patching costs, which can be substantial, allows a thicker overlay to be placed. Current IDOT policy allows overlay thickness to be increased as a tradeoff for reduced patching quantities; however, complete elimination of patching is not advocated. Unfortunately, there are very few projects of this nature available with carefully controlled variables for study at the present time. Some recently completed projects of this type include: IL 146 east of Golconda and IL 166 south of Creal Springs (District 9), and IL 251 near the junction of US 30 (District 2). Additional research is needed to examine the cost-effectiveness of this approach.

4.3.3 Further Screening of Projects and Experimental Design

The large number of projects with detailed information provided by the districts in the second survey provided a good pool from which to select a subset of projects for detailed performance and life cycle cost analysis. Several criteria were used to screen projects for the final set, including:

- Completeness of information available from surveys and interviews
- Year of treatment (Any projects completed in 1995 or earlier were considered for further screening, while projects constructed in 1996 and 1997 were entered into the database and will be considered as part of a future monitoring program)
- Balancing "experimental cells" based upon factors such as:
    - Climatic zone

- Strip versus area treatment
- Traffic level
- Number of years since treatment/overlay constructed

Based upon previous work (19), Illinois was broken into three climatic zones, based upon district boundaries, as follows:

Climatic Zones
Zone 1: Districts 1 and 2
Zone 2: Districts 3, 4, 5, and 6
Zone 3: Districts 7, 8, and 9

Based upon the time limitations of the study, a plausible experimental design was envisioned to contain the following factors and levels combined in a full-factorial experiment:

Experimental Design

Factor	Number of Levels	Description of Levels
Treatment	4	Strip, Area, Control/Strip, Control/Area
Climatic Zone	3	Northern, Central, and Southern Illinois

Replication = 8 projects per each combination of above factors

This plan required a maximum of 4*3*8 = 96 sections, although slightly less were actually required for a full experiment since several projects had strip and area treated portions, which could utilize a common control section. A total of 52 sections were selected for detailed analysis (see Table 4.1 and Appendix C), including strip, area, and control sections, with primary emphasis on strip and control sections. Obviously, it was not possible to fill in all cells of the experimental design, particularly with respect to control sections. Another gap in the experimental design was for area treated projects in northern Illinois (Zone 1), where only one project was available. Other factors that were considered but not possible to use as main factors included: rigid versus flexible base, overlay thickness, reflective crack control brand, and traffic level. However, it was not possible to include any of these as main factors in the experiment, due to the practical limitations in the number of sections available for study.

The breakdown of the 52 projects in the experimental design was: 26 strip, 17 area, and 9 control sections. This was felt to be large enough to provide a sufficient number of projects to evaluate cost-effectiveness based upon several key variables, but small enough to permit detailed performance history to be collected and analyzed.

Table 4.1. Experimental Cells for Detailed Performance Analysis

	Zone I					Zone II					Zone III				
Reflective Crack Control Application Method	Contract Number	Year Completed	District	Traffic Class	Control Section	Contract Number	Year Completed	District	Traffic Class	Control Section	Contract Number	Year Completed	District	Traffic Class	Control Section
Strip	34005	88	1	NA		86102	90	3	2	Y	94220	93	7	1	
	80230	89	1	NA		86139	91	3	3		94331	93	7	2	
	80238	89	1	NA		86230	91	3	2		96286	91	8	2	
	80677	91	1	NA		88044	88	4	2	Y	96417	92	8	3	
	82845	95	1	1		88114	91	4	3		98126	91	9	3	
	84509	95	2	2		88155	92	4	2		98129	92	9	2	
	84832	94	2	1		88180	91	4	1		98186	94	9	1	
	84837	95	2	1		90428	95	5	3		98240	93	9	3	
						90527	95	5	2	Y					
						92444	95	6	NA						
Area	84995	95	2	3	Y	40229	86	4	2	Y	95135	94	7	3	
						86139	91	3	3		95153	94	7	3	
						88019	88	4	3	Y	96539	94	8	1	Y
						88205	93	4	2		98126	91	9	3	
						88621	95	4	2		98193	94	9	1	
						92766	95	6	NA	Y	98201	92	9	1	
						93061	93	6	NA		98210	94	9	3	
						93168	93	6	NA		98278	95	9	2	

Notes/Key:
Y= Yes
NA= Not Available
IL 4/13, in District 8 (Contract #96384, not listed above), was used as an overall control section, although this project did not have any adjacent treated areas.

4.3.4 Use of Projects not Selected for Detailed Analysis

Although only about one-fourth of the projects identified by the districts fit into the experimental plan, all of the projects and corresponding information collected were entered into a database that was used to generate useful statistical trends concerning reflective crack control usage. The database was also used to establish ranges and averages of values, such as statewide costs of strip and area reflective crack control treatments, etc. These analyses and results are presented in Section 4.5.

4.4 CRS Database

The Illinois Department of Transportation, as part of its pavement management system, collects video logs of pavement surfaces from which serviceability and individual pavement distresses can be determined using the Condition Rating Survey (CRS) system. Pavement distresses and CRS rating information were solicited and stored on a database to serve as the performance data for the study. Figure 4.1 presents the distress level definitions used in the CRS system for bituminous surfaces. The overall CRS rating, which is a composite serviceability rating based upon a weighted average of the individual distresses, ranges from 1 to 9. A value of 9 is indicative of new construction, and rehabilitation is generally programmed when the CRS falls to about 5. The CRS distresses are determined from district reviews of video logs, which are collected by IDOT's Pavetech van (distress survey vehicle). In addition to the collection of four simultaneous video logs, the Pavetech vehicle also measures rut depth using laser extensometers, and computes and records the International Roughness Index (IRI).

CRS data was obtained with the help of IDOT's Office of Planning and Programming (OP&P), using the Illinois Roadway Information System (IRIS) and CRS databases. Before requesting CRS data from OP&P, the following information was collected for each job:

- Contract Number
- County Name
- Marked Route Name
- Stationing
- Needed CRS History Years

The data received from OP&P, which was furnished on printed hardcopy, was entered into a CRS database. The programming of this database is described in the following section.

4.5 Statewide Trends in Reflective Crack Control Systems

Since the database developed is the largest of its kind ever developed in Illinois, a unique opportunity existed to evaluate statewide statistical trends concerning as-built reflective crack control items, including:

Alligator Cracking

L1 - Low level: Hairline cracks with none or only a few interconnecting cracks. Cracks are not spalled.
L2 - Medium level: Further development of interconnecting cracks into a pattern. Cracks may be lightly spalled.
L3 - High level - Infrequent: Cracks have progressed so that the pieces are well defined and/or spalled at the edges.
L4 - High level - Frequent: Cracks have progressed so that the pieces are well defined and/or spalled at the edges.

Block Cracking

M1 - Low level: Hairline cracks with none or only a few interconnecting cracks. Cracks are not spalled.
M2 - Medium level: Further development of interconnecting cracks into a pattern. Cracks may be lightly spalled.
M3 - High level - Infrequent: Cracks have progressed so that the pieces are well defined and/or spalled at the edges.
M4 - High level - Frequent: Cracks have progressed so that the pieces are well defined and/or spalled at the edges.

Rutting- manual entry not required; measured by VIV sensors

N1 - Non-Continuous: Rut is less than or equal to 1/2".
N2 - Continuous: Rut is less than or equal to 1/2".
N3 - Continuous: Rut is greater than 1/2".

Transverse Cracking/Joint Reflection Cracks

O1 - Beginning Stage: Hairline cracks at any frequency.
O2 - Infrequent: Cracks are open and less than or equal to 1/4" in width and may have low to moderate levels of associated distress.
O3 - Frequent: Cracks are open and less than or equal to 1/4" in width and may have low to moderate levels of associated distress.
O4 - Infrequent: Cracks are greater than 1/4" in width and may have moderate to severe levels of associated distress.
O5 - Frequent: Cracks are greater than 1/4" in width and may have moderate to severe levels of associated distress.

Overlayed Patch Reflective Cracking

P1 - Beginning Stage: Cracks are tight and the bituminous overlay is in very good condition in the vicinity of the cracks.
P2 - Infrequent: Cracks are less than or equal to 1/4" and may have low to moderate levels of associated distress.
P3 - Frequent: Cracks are less than or equal to 1/4" and may have low to moderate levels of associated distress.
P4 - Infrequent: Cracks are greater than 1/4" and may have moderate to severe levels of associated distress.
P5 - Frequent: Cracks are greater than 1/4" and may have moderate to severe levels of associated distress.

Longitudinal /Center of Lane Cracking

Q1 - Beginning Stage: Cracks are tight (width is less than or equal to 1/4") with little or no spalling.
Q2 - Infrequent: Cracks are between 1/4" and 1/2" and may have minor spalling.
Q3 - Frequent: Cracks are between 1/4" and 1/2" and may have minor spalling.
Q4 - Infrequent - One or more of the following conditions exist:
- Cracks are greater than 1/2" in width
- Cracks have severe spalling
- Major maintenance activity has been performed on the crack

Q5 - Frequent - One or more of the following conditions exist:
- Cracks are greater than 1/2" in width
- Cracks have severe spalling
- Major maintenance activity has been performed on the crack

Reflective Widening Crack

R1 - Beginning Stage: Cracks are tight (width is less than or equal to 1/4") with little or no spalling.
R2 - Infrequent: Cracks are between 1/4" and 1/2" and may have minor spalling.
R3 - Frequent: Cracks are between 1/4" and 1/2" and may have minor spalling.
R4 - Infrequent - One or more of the following conditions exist:
- Cracks are greater than 1/2" in width
- Cracks have severe spalling
- Major maintenance activity has been performed on the crack

R5 - Frequent - One or more of the following conditions exist:
- Cracks are greater than 1/2" in width
- Cracks have severe spalling
- Major maintenance activity has been performed on the crack

Centerline Deterioration

S1 - Tight cracking with little or no spalling.
S2 - Cracking with low to medium spalling.
S3 - Infrequent: Cracks are open with medium to severe spalling.
S4 - Frequent: Cracks are open with medium to severe spalling.

Edge Cracking

T1 - Low or moderate cracking with no breakup or raveling.
T2 - Low or moderate cracking with some breakup and/or raveling.
T3 - Infrequent: Cracking with considerable breakup and/or raveling.
T4 - Frequent: Cracking with considerable breakup and/or raveling.

Permanent Patch Deterioration

U1 - Patch has little or no deterioration. Cracks and/or edges are tight. No settlement has occurred.
U2 - Patch is moderately deteriorated. Cracks and/or edges have opened. Settlement is less than 1/2".
U3 - Infrequent: Patch is badly deteriorated. The cracks and/or edges are severe. Patch replacement may be required.
U4 - Frequent: Patch is badly deteriorated. The cracks and/or edges are severe. Patch replacement may be required.

Shoving, Bumps, Sags, and Corrugation

V1 - Minor vehicle vibration.
V2 - Moderate vehicle vibration.
V3 - Excessive vehicle vibration.

Weathering/Raveling/Segregation/Oxidation

W1 - Infrequent: Low to medium level of distress.
W2 - Frequent: Low to medium level of distress.
W3 - Infrequent: High level of distress.
W4 - Frequent: High level of distress.

Reflective D-Cracking

X1 - Asphalt overlay on D-cracking-susceptible pavement; no distress reflecting through the overlay. NOTE: This is a special use code and does not need to be entered during a condition rating survey. Please contact the Office of Planning and Programming before using this code.
X2 - Asphalt overlay beginning to reflect D-cracking through the resurfacing. Little or no maintenance is required.
X3 - Asphalt overlay with well-defined reflective D-cracking; maintenance is required.

Figure 4.1. Determination of IDOT's Condition Rating Survey (CRS) Distress Levels (22)

- Average installed cost of strip reflective crack control treatment versus quantity
- Average installed cost of area reflective crack control treatment versus quantity
- Range and mean of leveling binder and overlay lift thickness used historically
- Location of reflective crack control within the overlay

Figures 4.2 and 4.3 illustrate average installed costs of strip and reflective crack control treatment versus quantity. Boxes were drawn around natural groupings of data, excluding clear outliers, and averages were obtained for each grouping. Based upon these analyses, the following results were obtained, as summarized in Tables 4.2 and 4.3:

Table 4.2. Average Statewide Installed Reflective Crack Control Costs: Strip

Quantity, linear feet (m)	Cost, $/linear foot ($/m)
<18,000 (5,486)	0.51 (1.67)
18,000-100,000 (5,486 - 30,480)	0.30 (0.98)
>100,000 (30,480)	0.23 (0.75)

Table 4.3. Average Statewide Installed Reflective Crack Control Costs: Area

Quantity, square yards (m^2)	Cost $/square yard ($m^2$)
< 20,000 (16,722)	1.23 (1.47)
20,000-70,000 (16,722-58,520)	0.84 (1.00)
>70,000 (58,520)	0.65 (0.78)

The breakpoint between small- and medium-sized projects is roughly 1 mile (1.6 km) of two-lane highway, when the areas of coverage listed in Tables 4.2 and 4.3 are averaged and rounded to the nearest mile. The breakpoint between medium- and large-sized projects is roughly 6 miles (9.7 km) of two-lane highway, using the same approach. These approximate breakpoints are based upon the use of three strips of strip reflective crack control treatment, e.g., one strip over each of the two reflective widening joints and one strip placed at the centerline joint.

Additional plots were generated to see if fabric costs had decreased with time, as was reported by several engineers from the districts. The analysis showed that there was not such a trend for either strip or area treatments, e.g., the costs have remained essentially constant over the past 15 years. This probably reflects an offset in cost savings though increased historical usage and competition between geotextile manufacturers with cost increases resulting from inflation.

Table 4.4 summarizes other useful statistics derived from the database. The average total overlay thickness for projects in the database was 2.3 inches (58 mm). This represents the average total overlay thickness, consisting of the leveling binder course and any other binder and surface course lifts placed at the time of the most recent rehabilitation (e.g., when fabric was last

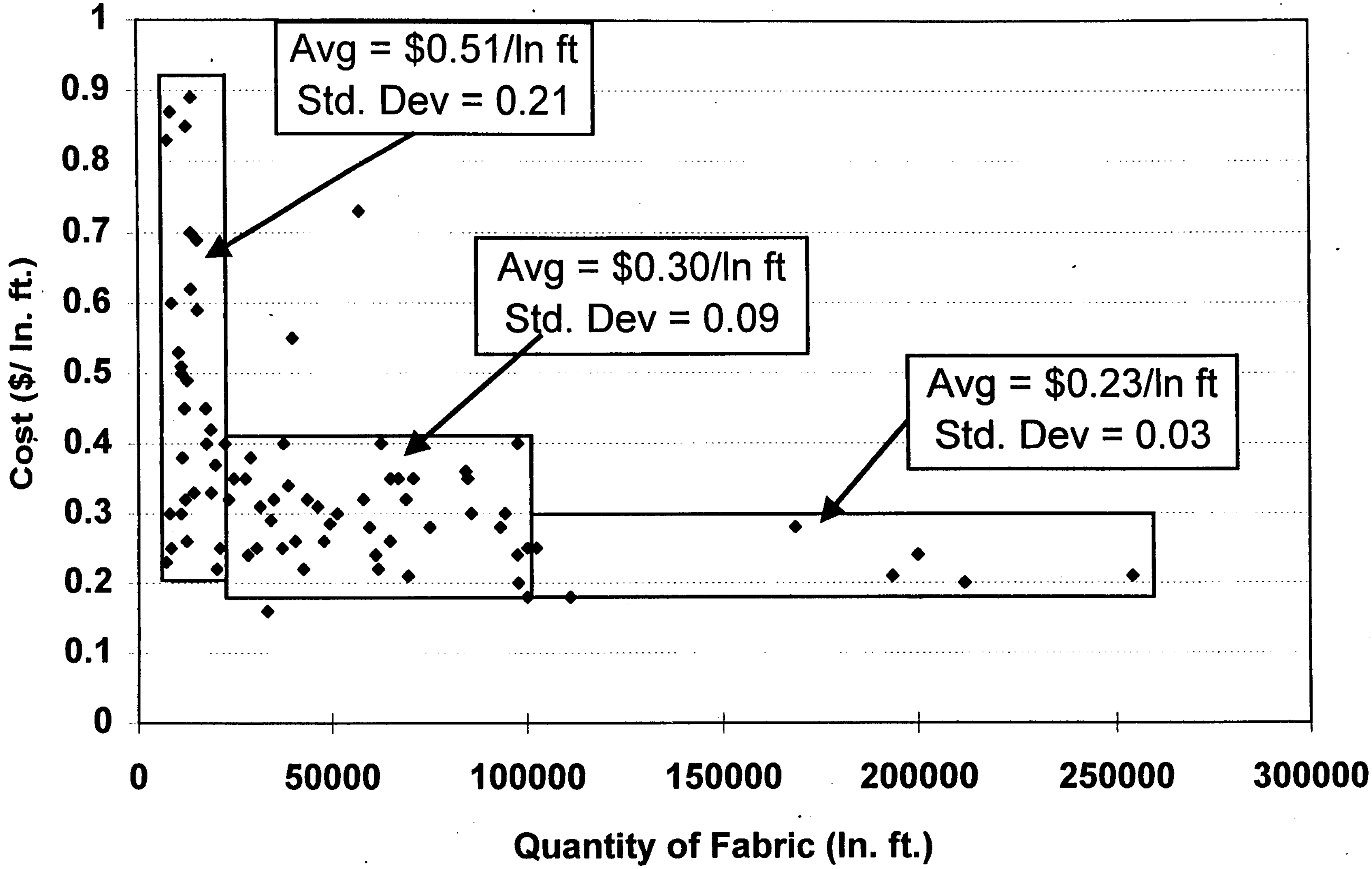


Figure 4.2. Average Installed Cost of Strip Reflective Crack Control Treatment Versus Quantity

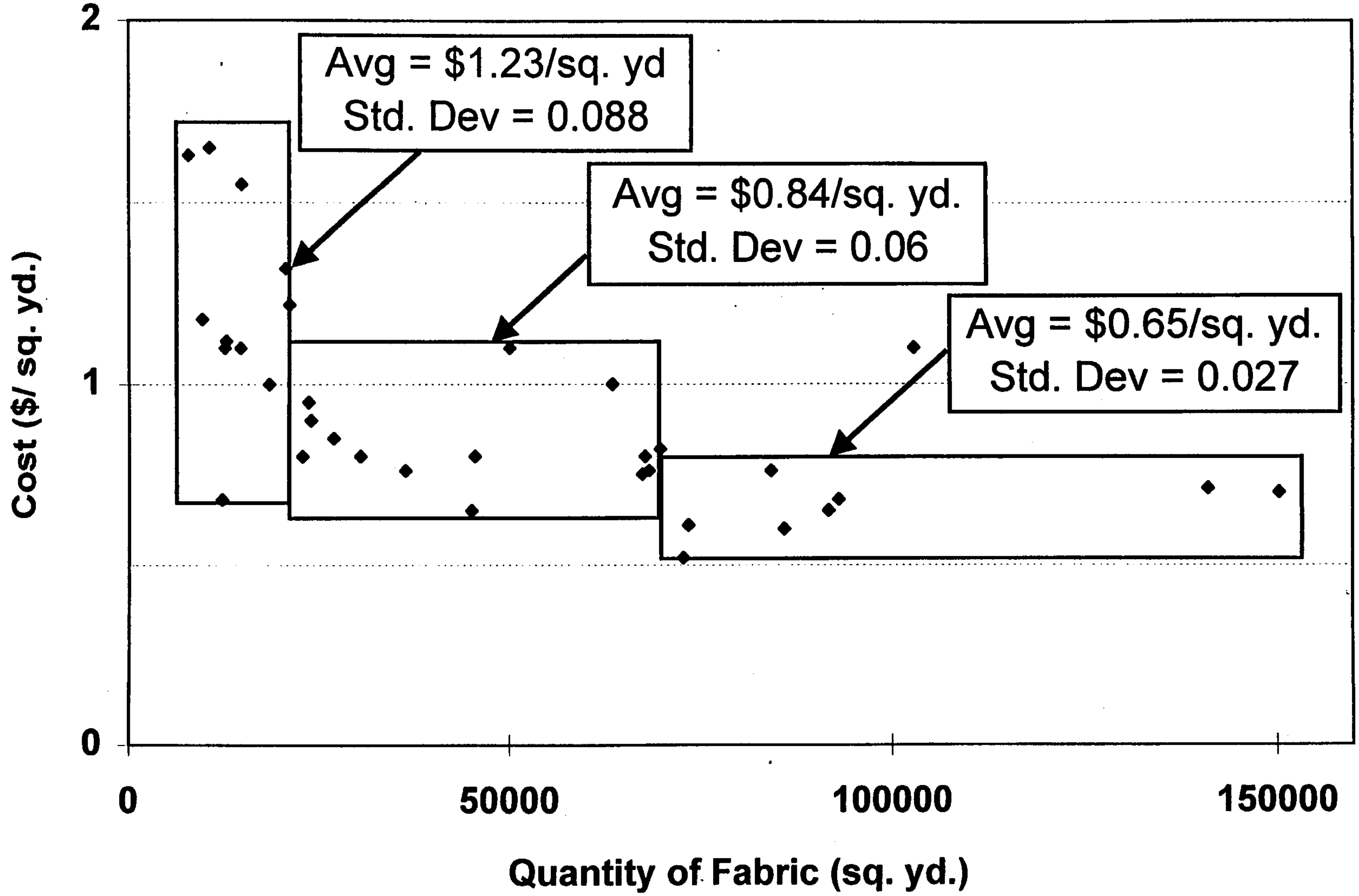


Figure 4.3. Average Installed Cost of Area Reflective Crack Control Treatment Versus Quantity

placed). This total does not include the thickness of previous bituminous overlay lifts. Fabric was placed on top of a new leveling binder course lift for 62 percent of the projects reported, and placed directly on an existing surface, usually a rotomilled bituminous surface, for the other 38 percent of projects. The average leveling binder course used was found to be 1.1 inches (28 mm).

Table 4.4. Statewide Trends for Overlay Thickness and Fabric Placement

Item	Average	High	Low
Total Overlay Thickness, inch (mm)	2.3 (58)	5.5 (140)	1.5 (38)
Leveling Binder Course Thickness, inch (mm)	1.1 (28)	2.8 (71)	0.6 (16)

Chapter 5

Performance Assessment

5.1 Overview

This chapter presents an assessment of the performance of reflective crack control treatments used in Illinois. The underlying goal of the assessment was to predict the life-span of overlays, with and without fabric interlayers, so that the cost effectiveness of the treatment methods could be evaluated (Chapter 6). The 52 projects selected for this assessment (Chapter 4), have the following characteristics:

- IDOT reflective crack control System A
- Rigid bases

Performance was assessed using several methods, including:

- District surveys (follow-up surveys, Appendices B and C)
- Review of the department's Pavetech video logs of pavement surfaces
- Collecting and analyzing CRS results
- Crack mapping

Background information on the CRS system is presented in Chapter 4.

Distress and serviceability results are presented for all 52 projects selected for detailed study, and an interpretation of results is presented. Projects having treated and untreated portions (control sections) are given special emphasis.

5.2 Comparison of Performance Assessment Methods

The performance of projects considered in the study was assessed by reviewing surveys, viewing Pavetech video logs, collecting CRS results, and by crack mapping. This section discusses the pros and cons of the various methods and describes the rationale for selecting the CRS system as the basis for estimating overlay life span, which is used in Chapter 6 to compute life cycle costs. Details concerning Pavetech and CRS were presented in Chapter 4.

As indicated in Appendix C, performance was reported in a subjective manner on district surveys, and in many cases, details were not furnished. The relative pros and cons of the remaining performance assessment methods can be summarized as follows:

- Crack Mapping:
  - Pros: Most current and accurate assessment of crack frequency and severity
  - Cons: Time consuming

- Pavetech Video Logs:
  - Pros: Quicker and safer than field surveys
  - Cons: Resolution limitations restricts identification of narrow cracks (minimum resolvable crack width is approximately 0.12 inch (3.2 mm))

- Utilization of CRS Results:
  - Pros: Quickest method to obtain results
  - Cons: Same cons as Pavetech (CRS is based upon Pavetech videos), also possibility of errors in distress categorization exist since reviewer may not be aware of underlying pavement conditions (e.g., widening crack interpreted as longitudinal crack)

Table 5.1 presents a summary of distresses as obtained from crack mapping and CRS. In general, distresses obtained from the CRS database corresponded well with field surveys. Most of the differences observed appear to be due to the fact that CRS results were from 1996 and 1997, while crack mapping was conducted in 1998. Thus, distresses as determined from crack mapping were, in many cases, more severe than CRS-based distresses. Due to the definitions used in the CRS system (Figure 4.1), frequently occurring distresses progress from levels 3 to 5, while infrequently occurring distresses often progress from level 2 to 4. This is reflected in Table 5.1, where cracks identified at severity level 3 based upon 1996 CRS results were often observed to be at severity level 5 in 1998. A second factor, possibly contributing to the observed discrepancies, is the inability of Pavetech to identify narrow cracks due to video resolution limitations. In cases where the limits of a project under consideration spanned over several CRS segments, there were several instances where some of the CRS segments were reported to have CRS distresses at certain level, while other segments were reported to be without the given distresses. In these cases, the percent of project length having the given distress level was computed, as indicated by footnote 5 of Table 5.1.

Based upon the above considerations, the following strategy was developed for the efficient collection distress information:

- Collect and analyze CRS results for all 52 projects selected for detailed analysis
- Generate crack maps for each of the eight projects having control sections, plus IL 4/13, which was eligible to receive crack control, but did not receive such treatment.

Table 5.1. Comparison of Overlay Performance by Two Methods

CRS Distresses (Pavetech, 1996 or 1997 as indicated) [1]	Measured Cracking from Crack Mapping in 1998		Distress (Based upon Crack Mapping, 1998)
	Number of Transverse Cracks per 500ft Section [2]	Feet of Longitudinal Widening Reflective Cracks per 500 ft Section [3]	
District 2			
84995 (IL 251, Area Treatment, Date Completed: November 1995)			
Transverse Cracking (Level 3) in 1997.	3	0	Transverse Cracking (Level 4) (See crack mapping, Figure D1)
84995 (IL 251, Control Section, Date Completed: November 1995)			
Transverse Cracking (Level 3) in 1997.	4	80	Transverse Cracking (Level 4) (See crack mapping, Figure D2)
District 3			
86102 (IL 178, Strip Treatment, Date Completed: September 17, 1990)			
Transverse Cracking (Level 3) in 1997 Longitudinal Cracking (level 3) in 1997.	17	125	Transverse Cracking (Level 5) Longitudinal Cracking (Level 1) (See crack mapping, Figure D3)
86102 (IL 178, Control Section, Date Completed: September 17, 1990)			
Transverse Cracking (Level 3) in 1997 Longitudinal Cracking (level 3) in 1997.	14 (17) [4]	450 (530) [4]	Transverse Cracking (Level 5) (See crack mapping, Figure D4)
District 4			
40229 (US 136, Area Treatment, Date Completed: 1986)			
Transverse Cracking (Level 3) in 1996 Longitudinal Cracking (Level 1 - 2.6%)[5] in 1996 Reflective Widening Cracks (Level 1) in 1996	57	660	Transverse Cracking (Level 5) Longitudinal Cracking (Level 1) Reflective Widening Cracks (Level 1) (See crack mapping, Figure D5)
40229 (US 136, Control Section, Date Completed: 1986)			
Transverse Cracking (Level 3 - 86.2%)[5] in 1996 Reflective Widening Cracks (Level 1 - 86.2%)[5] in 1996	44	980	Transverse Cracking (Level 5) Longitudinal Cracking (Level 1) Reflective Widening Cracks (Level 1) (See crack mapping, Figure D6)

(Table continued on following page)

Table 5.1. (Continued) Comparison of Overlay Performance by Two Methods

District 4			
CRS Distresses (Pavetech, 1996 or 1997 as indicated) [1]	**Measured Cracking from Crack Mapping in 1998**		**Distress (Based upon Crack Mapping, 1998)**
	Number of Transverse Cracks per 500ft Section [2]	**Feet of Longitudinal Widening Reflective Cracks per 500 ft Section [3]**	
88019 (IL 9, Area Treatment, Date Completed: 1988)			
Transverse Cracking (Level 1) in 1996.	32	N/A [6]	Transverse Cracking (Level 3) Reflective Widening Cracks (Level 1) (See crack mapping, Figure D7)
88019 (IL 9, Control Section, Date Completed: 1988)			
Transverse Cracking (Level 1) in 1996 Reflective Widening Cracks (Level 1) in 1996	36	N/A [6]	Transverse Cracking(Level 3) Reflective Widening Cracks (Level 1) (See crack mapping, Figure D8)
88044 (US 34, Strip Treatment, Date Completed: 1988)			
Transverse Cracking (Level 3) in 1996. Reflective Widening Cracks (Level 1 – 79.9%) [5] and (Level 2 – 20.1%) [5] in 1996	43	825	Transverse Cracking (Level 5) Reflective Widening Cracks (Level 1) (See crack mapping, Figure D9)
88044 (US 34, Control Section, Date Completed: 1988)			
Transverse Cracking (Level 3) in 1996 Reflective Widening Cracks (Level 1) in 1996	26	980	Transverse Cracking (Level 5) Reflective Widening Cracks (Level 3) (See crack mapping, Figure D10)
District 5			
90527 (IL 130, Strip Treatment, Date Completed: September 27, 1995)			
Transverse Cracking (Level 3) in 1996.	34	0	Transverse Cracking(Level 5) Longitudinal Cracking (Level 1) (See crack mapping, Figure D11)
90527 (IL 130, Control Section, Date Completed: September 27, 1995)			
Transverse Cracking (Level 1 – 83.4%) [5] and (level 3 – 16.6%) [5] in 1996. Reflective Widening Cracks (Level 3 – 16.6%) [5] in 1996.	22	10	Transverse Cracking (Level 5) (See crack mapping, Figure D12)

(Table continued on following page)

Table 5.1. (Continued) Comparison of Overlay Performance by Two Methods

District 6			
CRS Distresses (Pavetech, 1996 or 1997 as indicated) [1]	Measured Cracking from Crack Mapping in 1998		Distress (Based upon Crack Mapping, 1998)
	Number of Transverse Cracks per 500ft Section [2]	Feet of Longitudinal Widening Reflective Cracks per 500 ft Section [3]	
92766 (US 66, Area Treatment, Date Completed: 1994)			
Transverse Cracking (Level 2) in 1997.	22 (North Bound) 8 (South Bound)	35 (North Bound) 0 (South Bound)	Transverse Cracking (Level 4) (See crack mappings, Figures D13 and D14)
92766 (US 66, Control Section, Date Completed: 1994)			
Transverse Cracking (Level 2) in 1997.	11 (North Bound) 14 (South Bound)	0 (North Bound) 0 (South Bound)	Transverse Cracking (Level 4) (See crack mappings, Figures D15 and D16)
District 8			
96384 (IL 4/13, Control Section, Date Completed: 1993)			
Transverse Cracking (Level 1 – 18.8 %) [5] in 1996.	0	0	No Cracks (See crack mapping, Figure D17)
96539 (IL 111 – South Bound, Area Treatment, Date Completed: 1994)			
No Cracks in 1996	16	0	Transverse Cracking (Level 3) (See crack mapping, Figure D18)
96539 (IL 111 – South Bound, Control Section , Date Completed: 1994)			
No cracks in 1996	15 [7]	0 [7]	Transverse Cracking (Level 3) (See crack mappings, Figures D19 and D20)

1 As reported by IDOT, based upon review of the Pavetech video logs. Uses weighted average over length of project.
2 Transverse cracks of at least one-half pavement width or greater were included in this total.
3 Total length of longitudinal widening cracks on both lanes of two-lane road.
4 The control section was 425-ft long. The number in parenthesis shows the extrapolated value corresponding to a 500-ft section.
5 Percentage indicates proportion of given distress over project length, as described in Section 5.2.
6 26-ft existing PCC pavement. Thus, there was no longitudinal widening joint under the overlay.
7 Average of two, 500-ft control sections (See Figures D19 and D20).

5.3 Performance Results: Serviceability and Distress Levels

5.3.1 Direct Comparisons: Measured Cracking in Adjacent Treated and Untreated Sections

Of primary interest in this research was the comparison of overlay performance for projects having both treated and untreated sections (control sections). From District surveys and interviews, a total of nine projects were identified as having untreated portions that could serve as control sections to evaluate the performance of reflective crack control treatments. Crack maps generated by surveying treated and untreated portions of these projects are presented in Appendix D. Crack locations and crack widths, in millimeters, are given on these figures.

Figures 5.1 and 5.2 present comparisons of measured reflective cracking for treated and untreated sections. All points below the unity line indicate a performance enhancement due to reflective crack control treatment, while points above the unity line indicate a "dis-benefit." In the case of longitudinal reflective widening cracks (Figure 5.1), reflective crack control system A appears to provide some crack retardation benefits. While only three of the eight sections showed any appreciable reflective widening cracks, all three of these sections (two with strip treatment and one with area) appeared to benefit from the use of fabric treatments. The reduction in longitudinal cracking ranged from 15 to 75 percent. The effect of these reductions on overall pavement serviceability is presented in a later section.

In the case of transverse cracking (Figure 5.2), only projects involving area wide reflective crack control were considered, since longitudinal strip treatment is not intended to mitigate transverse reflective cracking. As indicated by the equal dispersion of points above and below the unity line, area wide reflective crack control treatment does not appear to delay transverse reflective crack development. This result is not surprising, since paving fabrics, in general, do not posses the flexural stiffness required to reduce vertical movements at transverse joints in PCC slabs caused by heavy vehicular loads. Furthermore, thermally-induced tensile stresses are greater in the longitudinal direction, and have been shown to exceed the reinforcing capabilities of fabrics used in System A (*12*).

As evidenced by the crack maps presented in Appendix D, transverse crack widths were also similar between treated and untreated sections. For instance, US 136 (Figures D.5 and D.6) was observed to have similar transverse cracking widths, predominantly 0.3 to 0.4 inches (8 to10 mm), throughout the treated and untreated sections. Thus, cracks were not observed to be any "tighter" in area treated pavement sections relative to untreated sections.

5.3.2 Global Comparisons of All Projects

This section presents global performance comparisons based upon the entire data set of 52 projects, focussing on differences in distresses and serviceability between strip treated, area treated, and untreated sections. Serviceability assessments are used to estimate useful overlay life, which is required for the economic analyses conducted in Chapter 6.

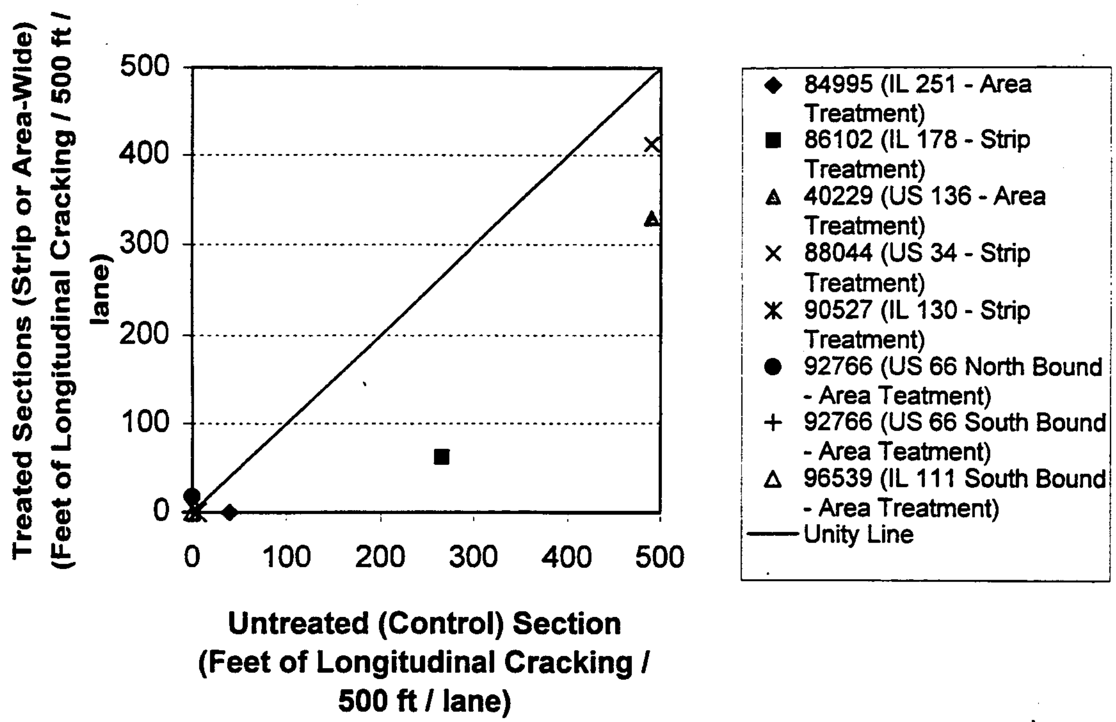


Figure 5.1. Comparison of Reflective Widening Crack Development: Treated Versus Untreated Sections

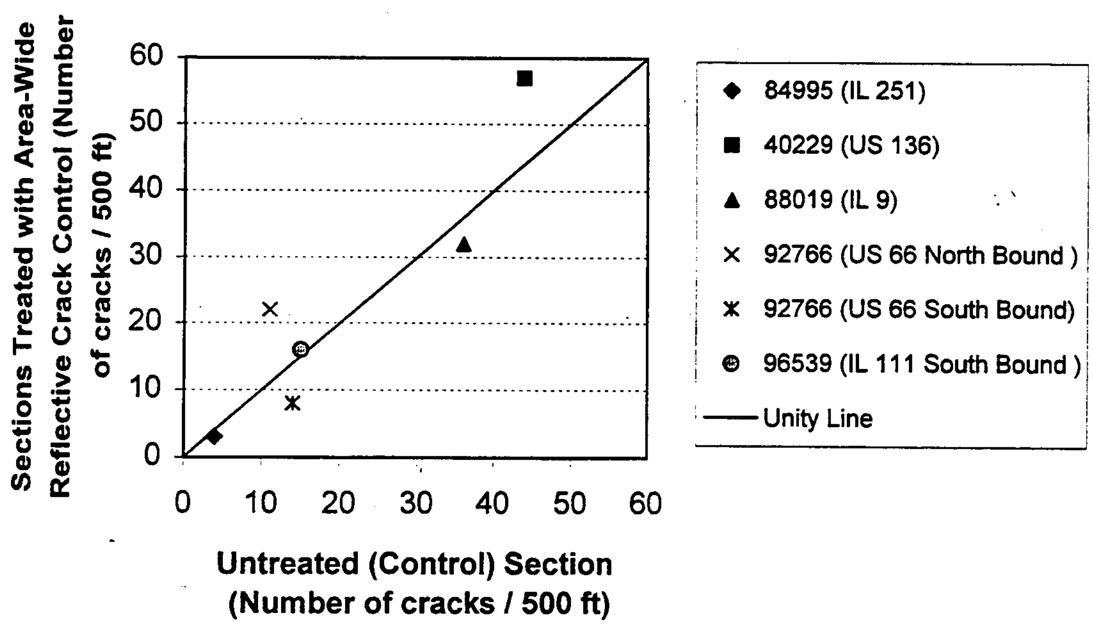


Figure 5.2. Comparison of Transverse Crack Development: Treated Versus Untreated Sections

5.3.2.1 Distress Level Comparisons

The following discussion centers on methods to compare two of the CRS distresses (see Figure 4.1) related to reflective cracking (R-reflective widening cracks, O-transverse reflective cracks) as a function of overlay age. The primary emphasis was on distresses R and O, since distress Q (longitudinal and center of lane cracking) depends upon several factors other than reflective cracking of the centerline joint. These other sources include segregation at center of lane joint and longitudinal wheel path cracking of the surface course. Furthermore, not all districts use strip reflective crack control to treat the centerline joint, as indicated in Appendix C.

The issue in developing global performance comparisons was to address the fact that the year of rehabilitation varied from project to project. A program was written in the Visual Basic programming language to query the CRS database (Chapter 3) and to collect and normalize the distress data relative to the year in which the overlay was completed. In this manner, all data could then be plotted against "overlay age." The second issue addressed was estimating an "average" distress versus age for a group of projects showing different levels of distress occurring at different ages. As shown in Figure 5.3, a method was developed to plot the percent of projects showing a given distress level versus overlay age. Six curves were plotted: a 'no distress' curve, and five other curves representing distress levels one through five for the particular distress being plotted. Each of these curves represented the percent of projects having at least the distress level indicated. To avoid clutter, each plot contains only one distress type.

As illustrated on Figure 5.3, this method provides reasonable results up to a certain overlay age, after which the trends become unreliable. The reason for the loss of data reliability at greater overlay ages is that the number of projects contributing data decreases as the overlay age increases. It was found that once the number of projects fell below three (usually at an overlay life of about seven years), the trends tended to become unreliable. Thus, as Figure 5.4 illustrates, the data was truncated beyond the age where the number of projects fell below three to produce a much more reliable set of curves. However, it was still difficult to obtain general performance trends, especially when comparing several plots simultaneously, from plots in the form illustrated in Figure 5.4. Thus, second-order polynomial trend lines were fit to the data and plotted as shown in Figure 5.5. Typically, the trend lines were forced to go through the origin of the plot, except for the "no distress" curve, which was forced to go through the 100 percent mark at year zero. This type of curve will hereafter be referred to as a *performance curve.*

A complete set of performance curves can be found in Appendix E. Annotated on these figures is the overlay age where 50 percent of projects reach a given distress level. This age will hereafter be referred to as the *median overlay age* to reach a given distress level. There are two properties of the performance curves that are worth mentioning. First, the 'no distress' curve and level-one (or greater) distress curve are, by definition, mirror images. Thus, these curves intersect at the 50 percent mark on the ordinate axis. A second expected trend is that each of the distress level lines (one through five) should plot from left to right without crossing. It should be noted that "interactions" are assumed negligible, e.g., strip, area, and control sections are assumed to have a relatively equal number of projects of varied traffic, environmental, material, and structural parameters. Given the fact that the final 52 projects were selected to balance these factors (Table 4.1), this assumption is valid.

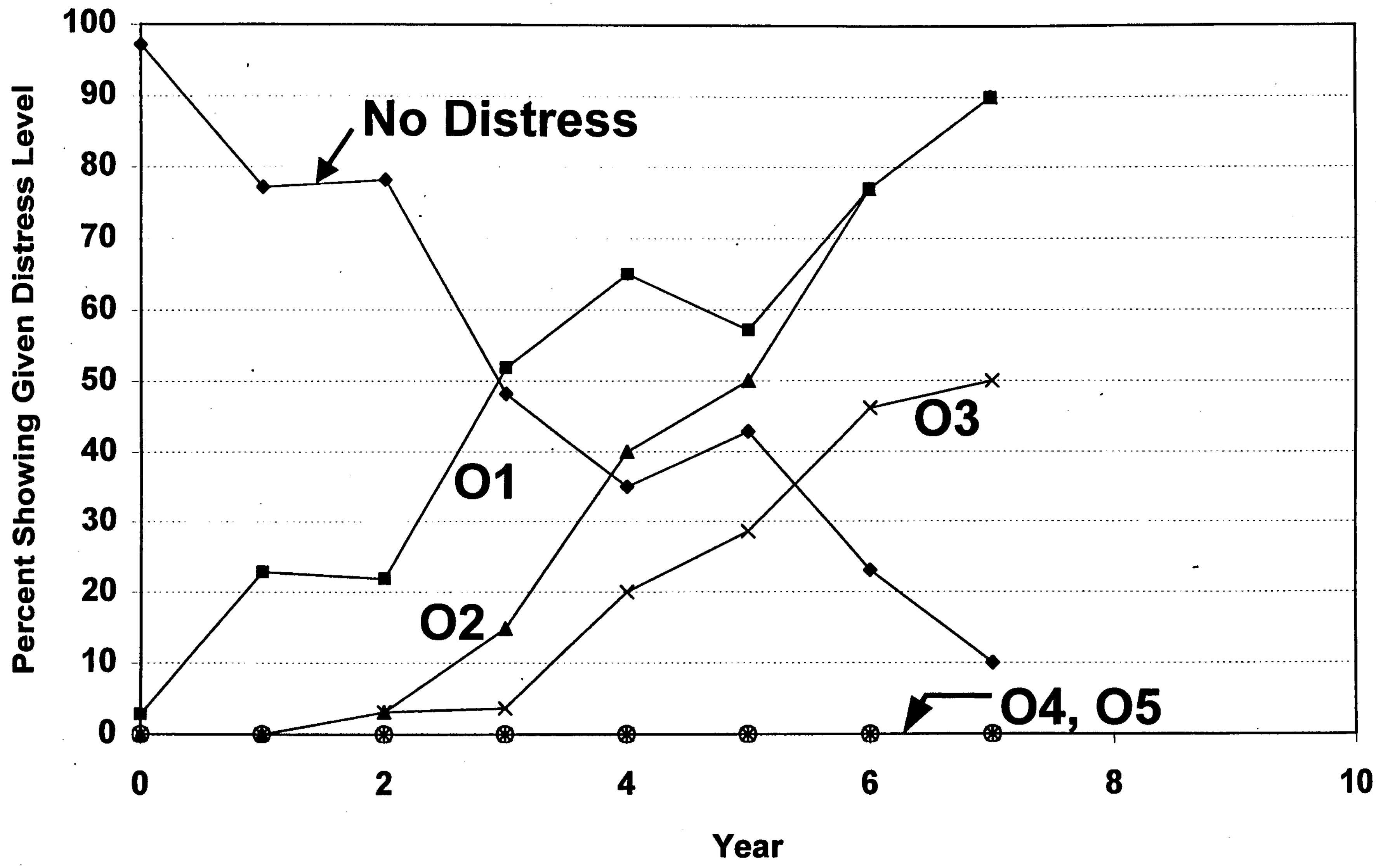


Figure 5.3. Performance Curve for Transverse Reflective Cracking, Original Raw Data

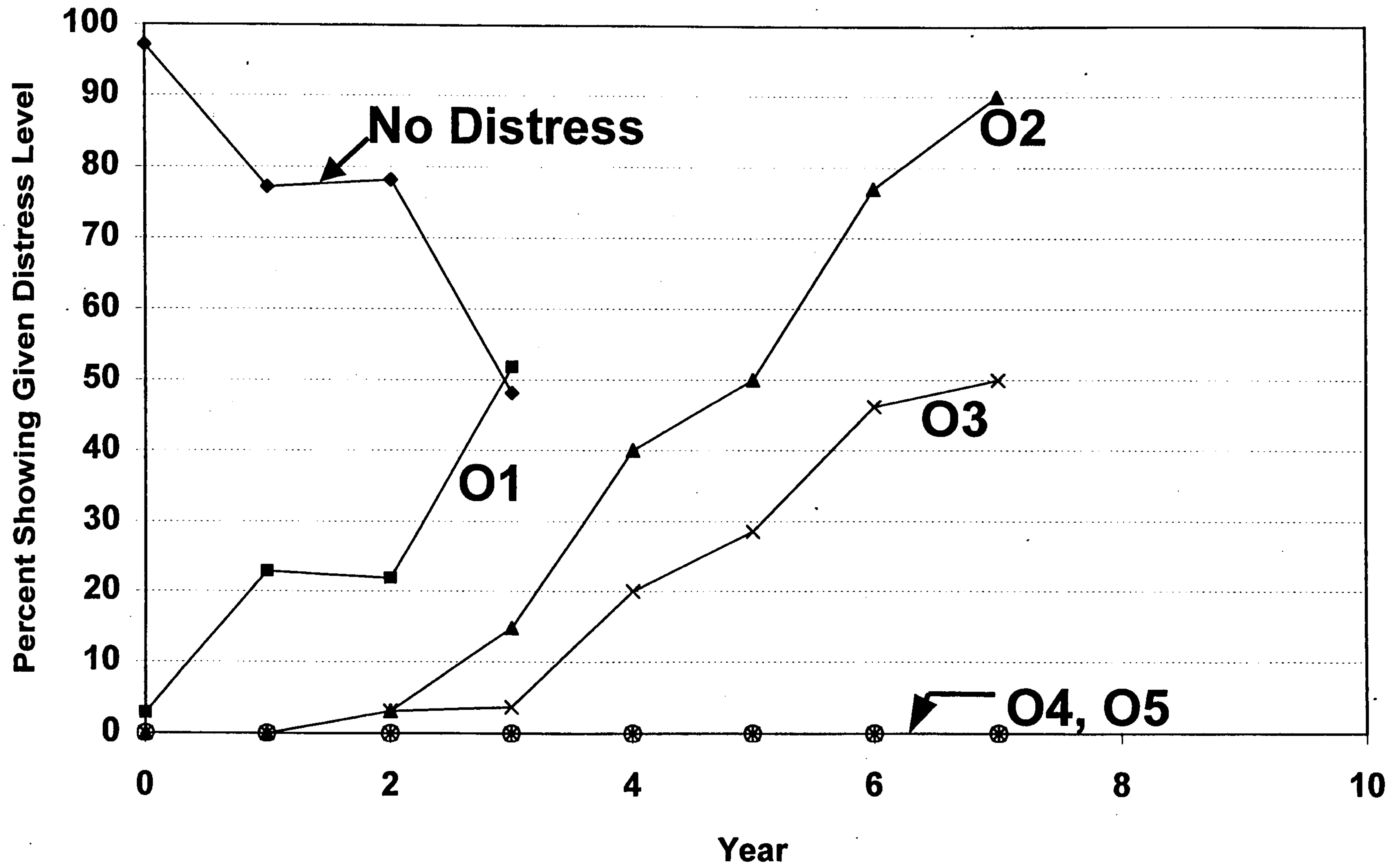


Figure 5.4. Performance Curve for Transverse Reflective Cracking, After Truncating

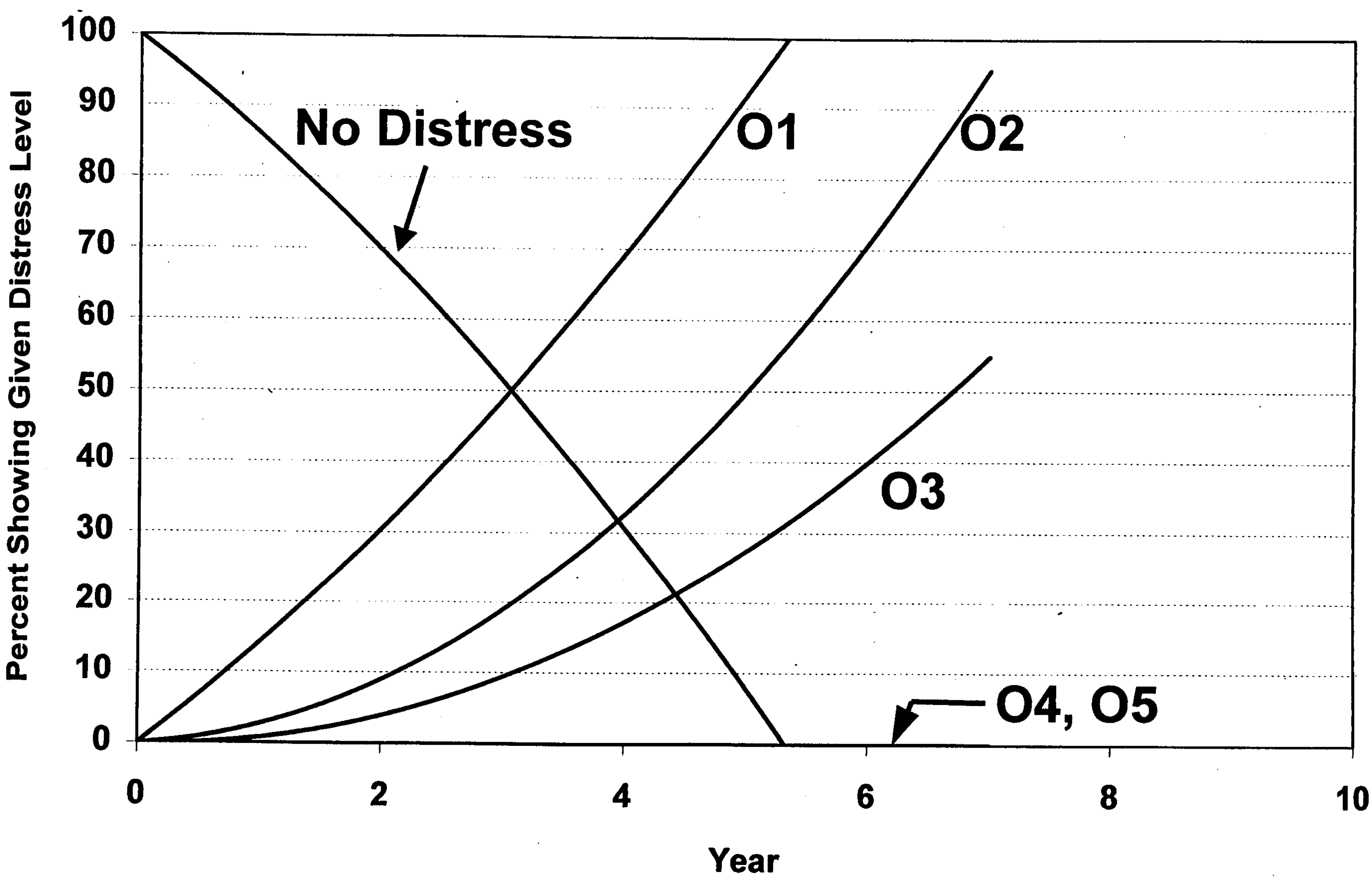


Figure 5.5. Performance Curve for Transverse Reflective Cracking, Showing Fitted Polynomial Trend Lines

Figures 5.6 and 5.7 present a concise and useful summary of the data presented in Appendix E. These figures indicate that very little difference in transverse and longitudinal reflective cracking is found to exist between treated and untreated sections, based upon CRS results. In terms of transverse cracking (Figure 5.7), this finding is in agreement with crack mapping results (Figure 5.2). Strip reflective crack control treatment placed over longitudinal joints is not intended or expected to retard transverse joint reflective cracking to an appreciable extent, so it would be unfair to compare the performance of strip treatment versus the control sections. Instead, the strip treated projects were conservatively considered as additional "control sections" for the evaluation of area treated projects, as indicated on Figure 5.7. Another useful piece of information that can be derived from this plot is that the median overlay ages for the development of O1, O2, and O3 distress levels is approximately 3, 5, and 7 years, respectively.

The longitudinal reflective widening crack mitigation benefits illustrated on crack maps (Figure 5.1) are not apparent in the CRS results. This is likely due to the fact that the global analysis can only be plotted reliably to seven years of overlay age with the current database. At seven years, longitudinal reflective cracks generally have only reached the initial stage (CRS level R1). The main differences in performance between treated and untreated sections observed in Figure 5.1 were at higher distress levels.

The median overlay age of seven years for the development of longitudinal reflective widening cracks at the R1 level, even for untreated sections, is an interesting finding. The minimum performance period required by the Federal Highway Administration on non-interstate or primary roadways is five years (*23*), while IDOT generally targets a 6- to 10-year rehabilitation life span (*24*). The fact that untreated sections appear to reach only the initial stages of reflective widening distress at seven years overlay age, suggests that the application of reflective crack control treatments over longitudinal joints may be unnecessary if subsequent rehabilitation will occur within 10 years of the placement of the overlay. On the other hand, if delays in subsequent rehabilitation beyond 10 years are a possibility, the presence of crack control treatments could be of benefit, as indicated by the points below the unity line at higher cracking levels in Figure 5.1.

The preceding analysis focussed on overlay performance in terms of specific distress levels, which are only part of overall overlay serviceability and life span. The following section presents overall serviceability of treated and untreated pavements as a function of overlay age.

5.3.2.2 Overall Serviceability Comparisons

Figures 5.8 through 5.10 present the overall CRS serviceability level versus overlay age for strip-treated, area-treated, and control sections. Best-fit straight lines were generated through data using least squares linear regression techniques, along with 95% confidence intervals. These relations were extrapolated to predict the overlay age where a CRS level of 5 would have been reached. For this study, a CRS level of 5 was considered the *rehabilitation trigger level*. In Illinois, a CRS of 6.0 is the transition from a rating of good to fair, and a CRS of 4.5 is the transition from fair to poor. A CRS rating of 5.0 allows for rehabilitation prior to a pavement

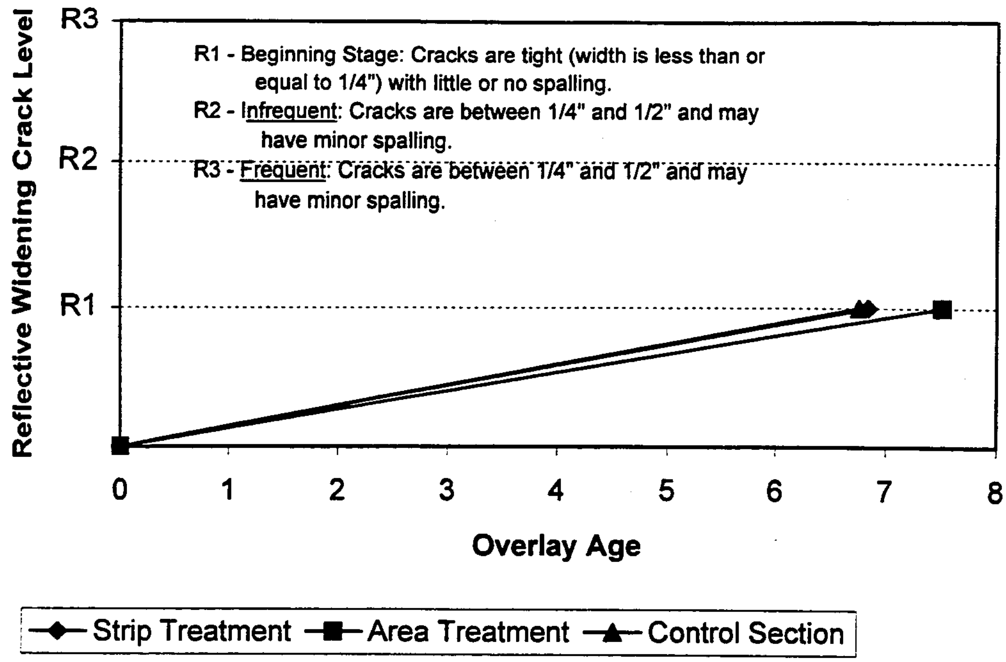


Figure 5.6. Median Overlay Age to Reach Various CRS - Based Distress Levels: Reflective Widening Crack

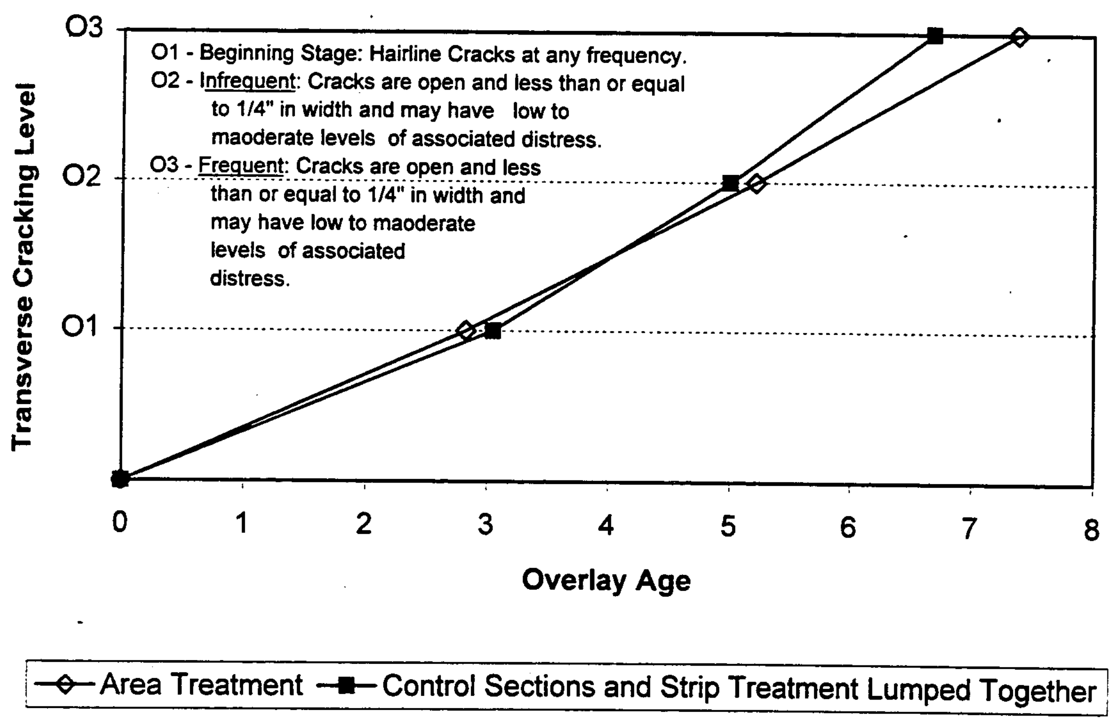


Figure 5.7. Median Overlay Age to Reach Various CRS - Based Distress Levels: Transverse Cracking

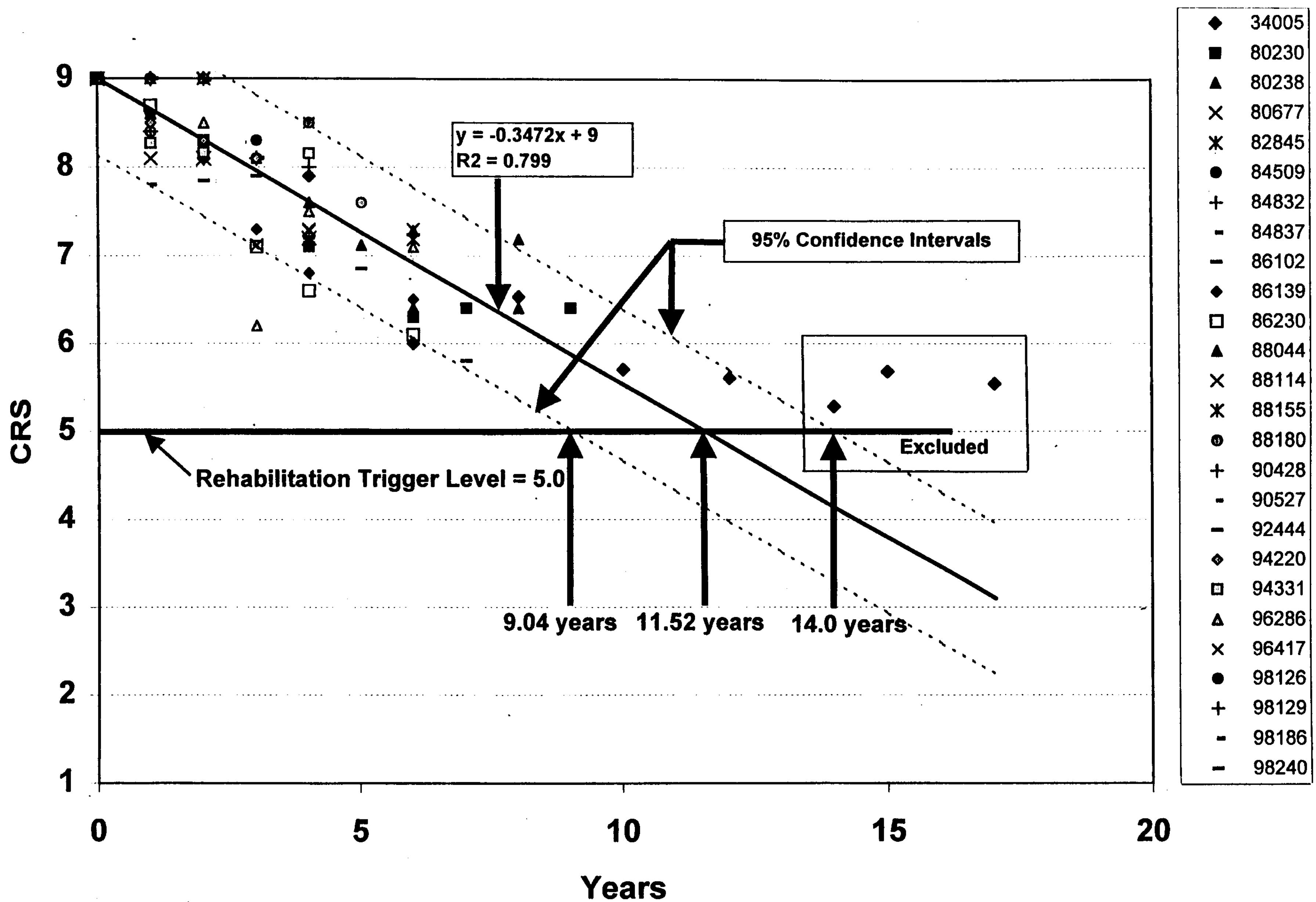


Figure 5.8. Regression Method to Determine Number of Years to Rehabilitation (CRS = 5.0); Strip Treatment

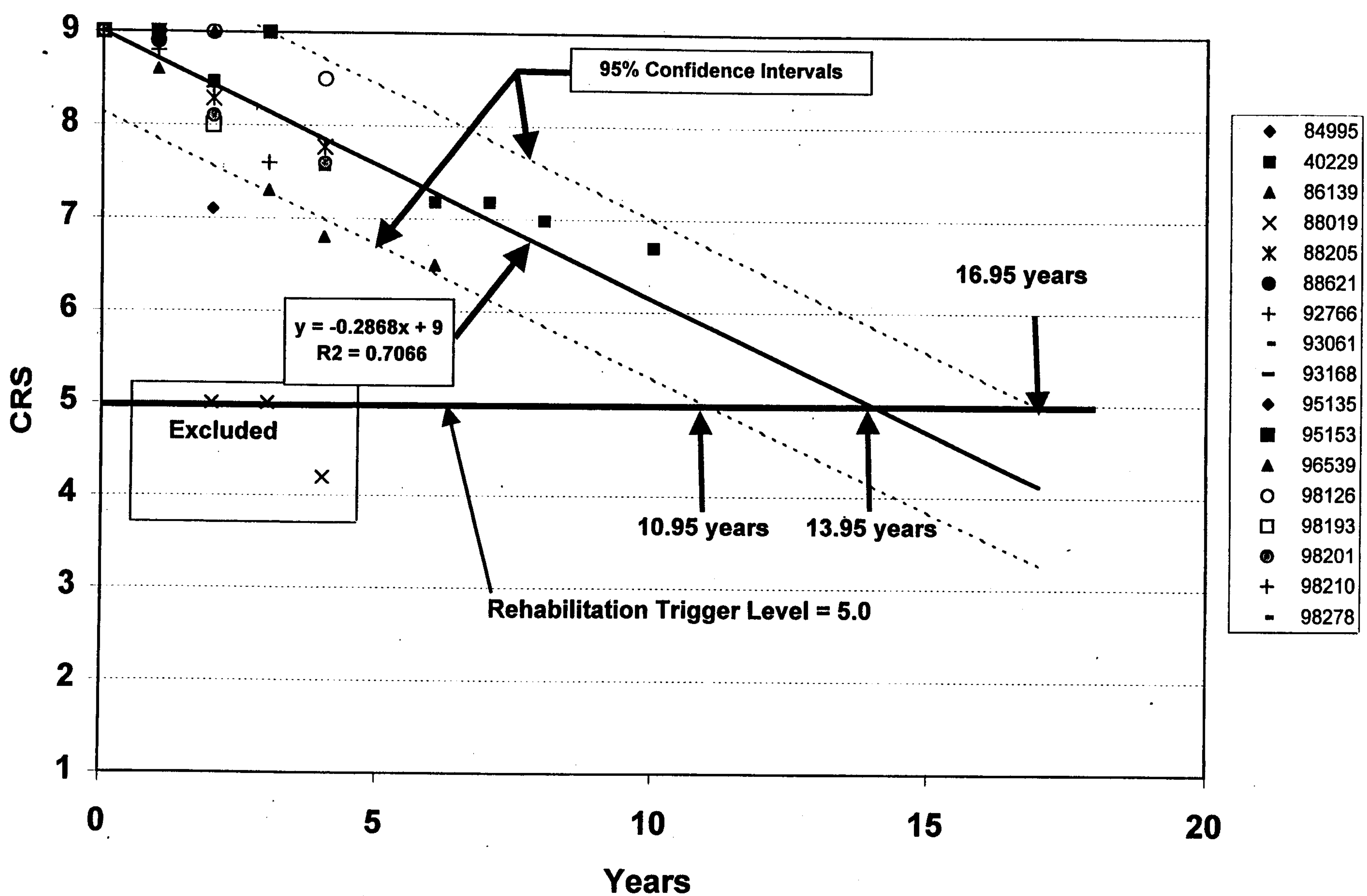


Figure 5.9. Regression Method to Determine Number of Years to Rehabilitation (CRS = 5.0); Area Treatment

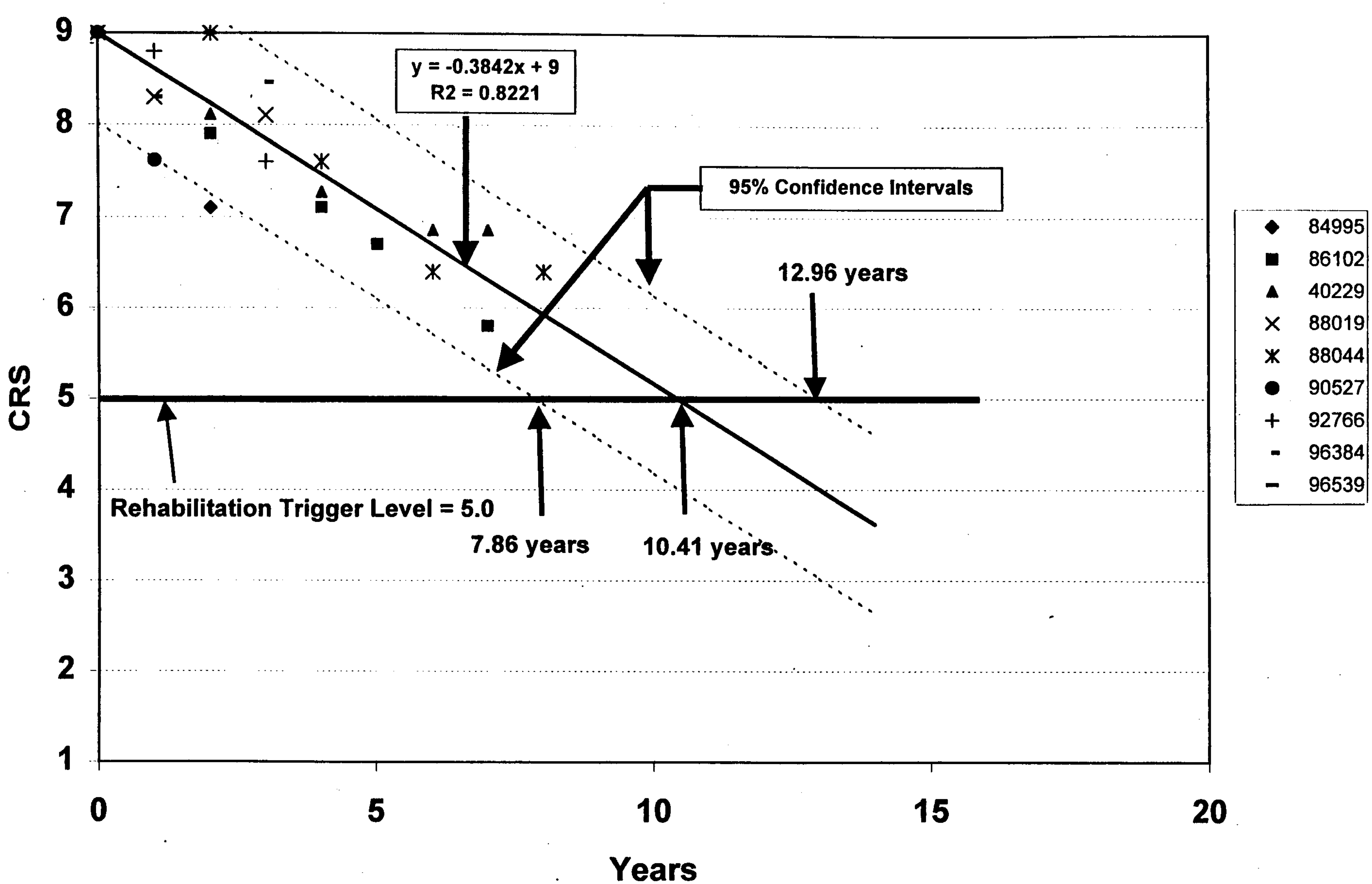


Figure 5.10. Regression Method to Determine Number of Years to Rehabilitation (CRS = 5.0); Control Section

receiving a poor condition rating. This quantity is of interest for establishing life cycle costing intervals, as described in the following chapter. Generally, CRS-versus-age curves are not linear, but in fact tend to become more horizontal at longer pavement ages due to benefits of routine maintenance. However, since the amount of extrapolation in Figures 5.8 through 5.10 was relatively minor, except for area-treated projects, the use of linear extrapolation was deemed a reasonable simplification. Predicted overlay life spans of 11.5, 14.0, and 10.4 years, for strip-treated, area-treated, and control sections were estimated.

5.4 Summary of Findings

The key findings of the analyses presented in this chapter are:

- For eight projects identified as having control sections (untreated portion(s)), crack maps were obtained, which allowed side-by-side comparisons of treated and untreated sections under similar conditions to be made. While only three of the eight control sections have experienced appreciable reflective widening crack development to date, measured reflective widening cracks were substantially retarded in each of these three sections (two treated with strip and one with area-wide reflective crack control treatment). The benefit of fabrics in the mitigation of measured transverse cracking was found to be minimal in these eight sections.
- In performance comparisons drawn from the entire database and utilizing CRS distress levels, differences between distress levels in treated and untreated portions were found to be negligible.
- On the other hand, overlay life spans were predicted to be increased when paving fabrics were used, based upon overall CRS serviceability ratings. Predicted overlay life spans of 11.5, 14.0, and 10.4 years, for strip-treated, area-treated, and control sections were obtained, based upon linear extrapolation of CRS-rating-versus-overlay-age relations to a rehabilitation trigger level CRS of 5.

Chapter 6

Economic Analysis

6.1 Overview

This chapter presents life cycle cost analyses performed to assess the cost-effectiveness of IDOT reflective crack control System A over rigid bases. Both strip and area-wide reflective crack control treatments were considered.

6.2 Life Cycle Cost Analysis (LCCA)

LCCA analysis is a powerful tool for comparing the cost-effectiveness of alternate rehabilitation strategies. LCCA utilizes standard economic formulas, which allow one to consider the time-value of money and the effects of delayed maintenance and rehabilitation when comparing alternate strategies. Therefore, LCCA requires an estimate of expected life span and anticipated maintenance costs associated with each candidate strategy. These and other required inputs are described in the following sections.

6.2.1 Life Span Determination

Two methods were used to estimate the useful lives of strip-treated, area-treated, and untreated overlay projects in the study: the regression method and average deterioration rate method.

6.2.1.1 Regression Method

This method involves simultaneous fitting of all data on a serviceability versus overlay age plot with a selected functional form. This was performed in Chapter 5, and presented in Figures 5.8 through 5.10. Once a rehabilitation trigger level is selected, the regression lines can be used to determine the life span of the rehabilitation method in question. In this case, the rehabilitation trigger level was set at an overall CRS rating of 5. The results of this analysis are given in Table 6.1, along with 95 percent confidence limits on the estimated life span.

Table 6.1. Estimated Life Spans Using the Regression Method

Treatment	Life Span (Years)	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Strip	11.5	9.0	14.0
Area	14.0	11.0	17.0
Control	10.4	7.9	13.0

In general a much better assessment of performance benefits will be possible in approximately two to three years as the performance database matures. The additional data available in the future will extend the grouping of data points closer to the rehabilitation trigger level. The amount of extrapolation required to predict overlay life span will be reduced, and confidence intervals will become narrower. At present, the least amount of extrapolation was required for strip-treated projects, where more projects and performance data were available.

6.2.1.2 Average Deterioration Rate Method

This method was used in determining overlay lifespan in IDOT Physical Research Report number 116 (*24*), and involves averaging deterioration rates from individual projects to obtain a single deterioration rate. This rate is then used to estimate overlay life span, as illustrated in Figure 6.1. To be consistent with the regression method, initial CRS after rehabilitation was taken as 9.0, and the rehabilitation trigger level was taken as 5.0. Individual deterioration rates were then determined by:

$$Rate\ of\ Deterioration = \frac{(\ 9.0 - Most\ Recent\ CRS\ Value)}{(Number\ of\ Years\ Between\ Most\ Recent\ CRS\ and\ Last\ Rehabilitation)}$$

These deterioration rates were plotted versus overlay age, as shown in Figure 6.2. Clearly, deterioration rates for projects less than three years old showed considerable scatter, as illustrated in Figure 6.2. Since these data were judged as unreliable, average deterioration rates were determined using projects having at least three years of performance data, as indicated in Figure 6.2. Using these average deterioration rates, the predicted life spans were computed by:

$$Life\ Span = \frac{(Initial\ Serviceability - Rehabilitation\ Trigger\ Level)}{(Average\ Deterioration\ Rate\,[ADR])} = \frac{9-5}{ADR} = \frac{4}{ADR}$$

The resulting life spans are given in Table 6.2. Figure 6.3 presents a comparison of life spans of strip-treated, area-treated, and untreated projects using each of the estimation methods. Given

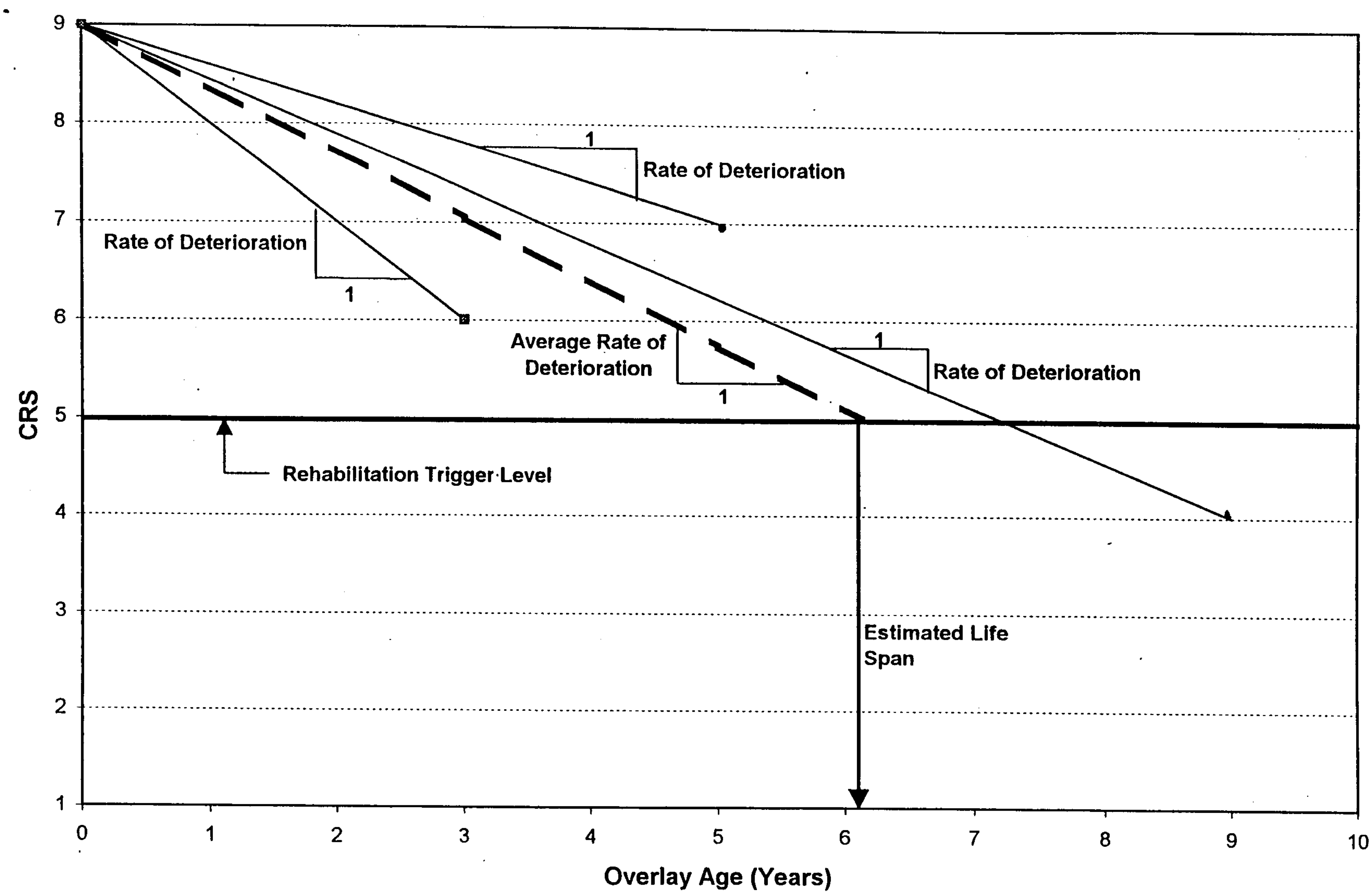
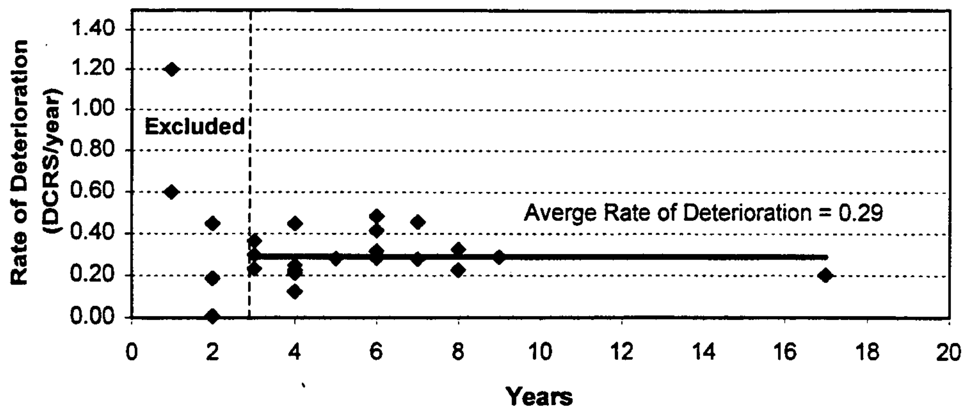
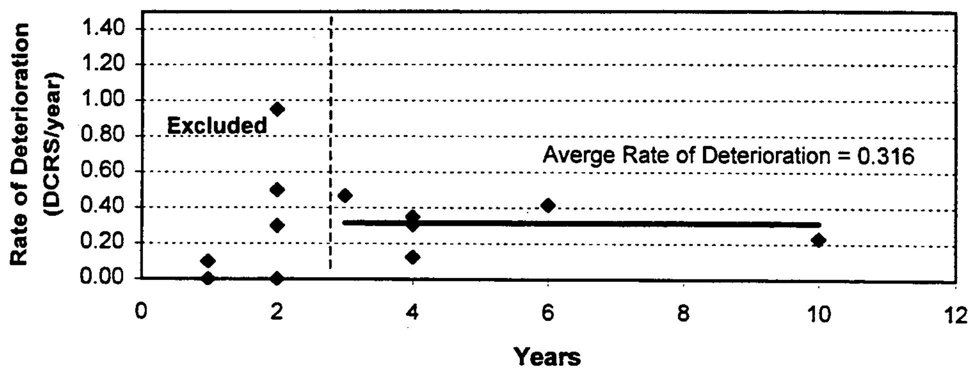


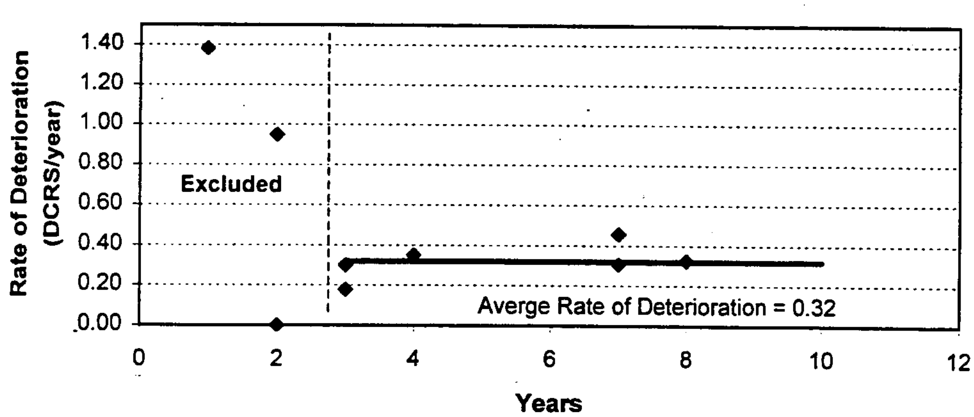
Figure 6.1. Conceptual Illustration of Average Rate of Deterioration Method



a) Strip Treatment



b) Area Treatment



c) Control Section

Figure 6.2. Determination of Average Rate of Deterioration

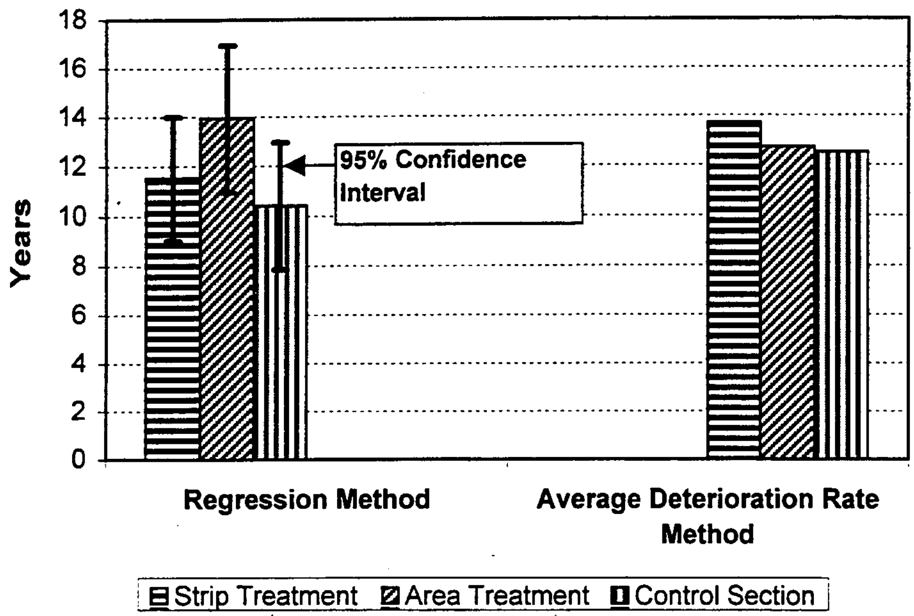


Figure 6.3. Estimated Life Span Based Upon CRS Rehabilitation Trigger Level of Five

the relatively small number of data points used to determine average deterioration rate after truncation (Figure 6.2), it was concluded that the regression method yielded more reliable life span prediction for the given data set. Nevertheless, both methods were used and compared in the subsequent LCCA.

Table 6.2. Estimated Life Spans Using the Average Deterioration Rate Method

Treatment	Estimated Life Span (Years)	Rate of Deterioration
Strip	13.7	0.290
Area	12.7	0.316
Control	12.5	0.320

6.2.2 LCCA Model and Other Required Inputs

LCCA were conducted using procedures recommended by the Federal Highway Administration (FHWA [*23*]). Life cycle costing can consider many cost components, particularly:

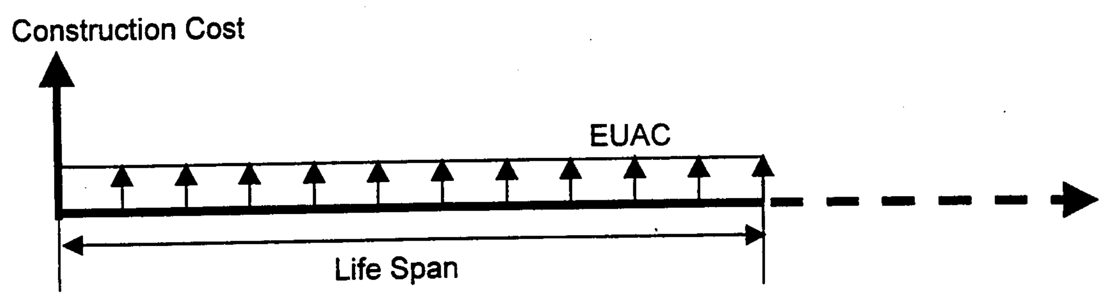
- Initial Construction Costs
- Maintenance Costs
- User Costs (Vehicle Damage, User Delay in Work Zones)
- Salvage Value

Life cycle costs were computed for two analysis cases, which included the following groups of cost components:

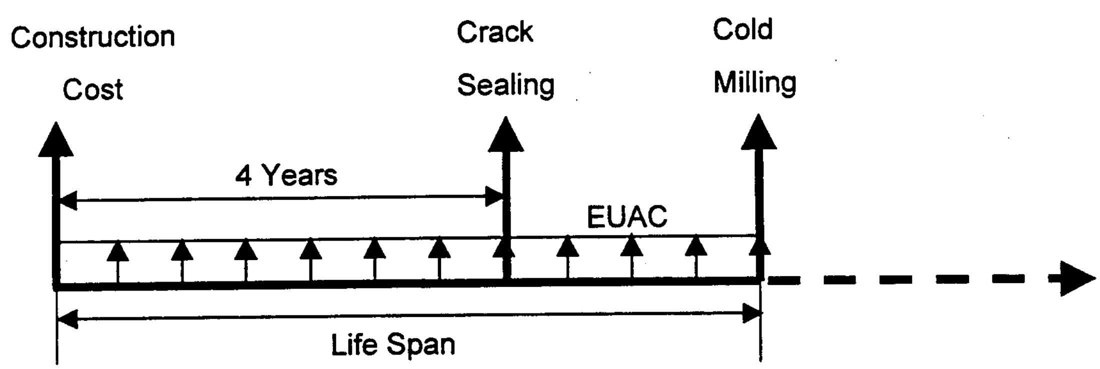
- Case 1 (Neglecting maintenance and milling costs):
  - Bituminous overlay cost, in-place (material plus construction costs)
  - In-place reflective crack control cost

- Case 2 (Maintenance and milling costs included):
  - Bituminous overlay cost, in-place (material plus construction costs)
  - In-place reflective crack control cost
  - Crack sealing costs
  - Milling costs (removal of previous overlay lift)

The LCCA modeling structures used in this study are graphically represented using expenditure stream diagrams, as shown in Figure 6.4. As illustrated, the equivalent uniform annual cost (EUAC) method was selected for translating economic elements to a common time period, accounting for the time effect of money. As the name suggests, the EUAC method equates life cycle costs to an equivalent annual cost that would be incurred over the analysis period to pay for the given rehabilitation.



a) Case 1: Neglecting Maintenance and Milling Costs



b) Case 2: Maintenance and Milling Costs Included

Figure 6.4. Expenditure Stream Diagram for Life Cycle Cost Analysis

The following sections describe the input values used in the LCCA, and document the sources and/or assumptions made in obtaining the input values.

6.2.2.1 Discount Rate

This is the factor used to account for the time value of money. A "real" discount rate was used, which is the appropriate rate to be applied when non-inflated future costs are used. Based upon FHWA guidelines, a discount rate of 5% was used.

6.2.2.2 Construction Costs

The following values, which were obtained from IDOT's Central Bureau of Design and Environment, were used in the LCCA:

- In-place cost of bituminous overlay = \$38/ton (\$41.90/metric ton)
- Cold milling = \$0.87/yd^2 (\$1.04/m^2)
- Crack sealing = \$0.30/ln. ft. (\$0.98/meter)

Average overlay thickness for the projects used to generate performance curves (Figures 5.8 through 5.10) were used in the computation of in-place bituminous overlay cost. The average overlay thickness for these projects were 2.2, 2.3, and 2.2 inches (56, 58, and 56 mm), for strip, area, and control sections, respectively. Only projects having overlay thicknesses in the range of 1.5 to 3.0 inches (38 to 76 mm) were used in the computation of average overlay thickness, to avoid the influence of outliers in this quantity, which directly influences the estimated overlay cost in the LCCA. Thus, the resulting average was in fact very close to the median overlay thickness. This is evident by reviewing overlay thicknesess in Appendix C, where the median overlay thickness used in the projects identified is around 2.25 inches (57 mm).

Reflective crack control costs were based upon the values given in Chapter 4 (Tables 4.2 and 4.3). Separate LCCA were conducted based upon installed reflective crack control costs for small, medium, and large projects. Milling costs were applied at the end of the life cycle. It was felt that this most realistically represented the cost associated with the partial removal of the bituminous overlay at the end of the performance period to regain profile. It is not known how the presence of fabric in the bituminous overlay system will affect future milling cost, so a value typical of normal milling conditions was used in the LCCA analysis, as given above. Furthermore, since IDOT typically only mills the overlay surface down to the point where rutting is removed and profile is restored, it is not known how often the presence of fabric will impact milling operations and the quality of reclaimed asphalt pavement (RAP). Future LCCA should consider the cost of milling on projects containing paving fabrics, once better estimates are available.

6.2.2.3 Maintenance Costs

The primary maintenance cost associated with reflective cracking is crack sealing. As a result of district interviews, it was determined that crack sealing was generally applied between three and five years after placement of the new overlay. In IDOT district 2, however, crack sealing is generally scheduled for the summer after the second complete winter that the overlay has been subjected to. Subsequent crack re-sealing is not a common practice in Illinois. As a result, a single crack sealing operation, occurring four years after overlay placement, was used for LCCA.

While reflective crack frequencies varied among projects in the study, it was desired to use an average crack frequency for the LCCA. Based upon the database developed in this study, the following crack patterns were used to determine crack sealing quantities per mile of 2-lane roadway:

- Transverse cracking: 30-ft intervals, thus: 176 cracks/mile * 24 ft/crack = 4224 ft/mile (800m/km).
- Longitudinal cracking: Both sides of 2-lane facility, appearing over 30% of length, thus: 2 sides * 0.3 * 5280 ft/mile = 3168 ft/mile (1200 m/km).

6.2.2.4 Other LCCA Elements

LCCA elements that were neglected in this study include user costs and salvage values. Since all rehabilitation strategies considered had similar CRS ratings for the beginning and end of the life cycle (e.g., CRS ratings of 9 and 5, respectively), and since subsequent rehabilitation was assumed to progress at the end of the performance period, salvage values did not need to be considered in this analysis. FHWA guidelines indicate that user costs associated with vehicular damage can be ignored, but that user delay costs during work zone operations be considered, if justified for the analysis being conducted. Differences in user costs between the rehabilitation strategies considered were assumed to be negligible for the projects considered in this study.

6.2.2.5 LCCA Computations

Life cycle costs were first computed by equating all construction and maintenance costs expected over the life span to present worth:

$$PW_j = \frac{Cost\ of\ Item\ j}{(1+i)^n} \tag{6.1}$$

Where:

PW_j = Present worth of item j
i = Discount rate = 5%
n = Time at which "future" cost was incurred, years

Next, EUAC was computed as follows:

$$EAUC = \sum_j PW_j * \frac{i}{1 - \frac{1}{(1+i)^m}} \quad (6.2)$$

Where:

m = Life span of rehabilitation method, years

All other quantities are as defined before.

6.2.3 LCCA Results

Tables 6.3 and 6.4 summarize the results of LCCA analyses conducted for life span predictions calculated from the regression method. Similar computations were made for life spans predictions calculated from the average deterioration rate method. Figure 6.5 presents a comparison of EUAC associated with strip-treated, area-treated, and untreated projects, for the two analysis cases presented in Section 6.2.2. These analyses were all conducted based upon reflective crack control costs associated with "medium-sized" projects, as defined in Tables 4.2 and 4.3. Lower EUAC's represent more cost-effective rehabilitation strategies.

Figures 6.5a and 6.5b compare life cycle costs (EAUC) for strip, area, and control sections, for the two sets of LCCA assumptions considered. Examination of Figure 6.5b reveals that projects treated with strip and area-wide reflective crack control treatment are slightly more cost-effective than untreated projects (about 4.5%), based upon the regression method, for medium-sized projects. However, as indicated by the overlapping 95% confidence intervals, there is no statistical difference in the three treatment methods. By comparing Figures 6.5a and 6.5b, it is evident that the relative ranking in EAUC results is the same regardless of whether or not maintenance and milling costs are considered in LCCA computations. In the average deterioration rate method, strip treatment is once again found to be slightly more cost-effective than the control case (2.8% lower life cycle costs), while area treatment is 18.4% more costly over the life cycle than the control case.

Figure 6.6 illustrates the effect of project size on life cycle costs, based upon the regression method and the average deterioration rate method for determining life span. This figure illustrates that the larger the project, the more cost-effective the use of reflective crack control treatments, due to cost savings in fabric purchased in large quantities. Strip-treated projects showed a life cycle cost savings of 4.9%, 4.0%, and 1.2%, for large, medium, and small projects, respectively. Area-treated projects showed a 7.6% and 4.7% life cycle cost benefit for large and medium sized projects, and a -1.2% life cycle cost benefit (e.g., a "dis-benefit") for small projects. Once again, based upon the uncertainty of life span predictions, the differences noted between treated and untreated projects are not statistically significant.

One would expect the regression method and average deterioration rate methods to yield similar results. This was true only for strip-treated projects, which had a larger collection of projects with longer performance histories than area-treated projects. For area-treated projects,

Table 6.3. Life Cycle Cost Analysis: Regression Method Based Upon Predicted Lifespan From Best Fit Trendline, Neglecting Maintenance and Milling Costs

Results for Medium Project Size

a) Sections Treated with Strip Reflective Crack Control

All Calculations for 1 mile

i =0.05

	Cash Flow Amount	n	1/(1+i)^n	PW of Cash Flow	
Construction Cost	$ 69,379.20	0	1	$ 69,379.20	
Cold Milling	$ -	11.52	0.57003	$ -	
Crack Sealing	$ -	4	0.8227	$ -	EUAC
			Total PW	$ 69,379.20	$ 8,067.95

Overlay Thickness = 2.2 inches
Fabric Cost = $ 0.30 /ln. ft.
Life Span = 11.52 Years

b) Sections Treated with Area-Wide Reflective Crack Control

All Calculations for 1 mile

i =0.05

	Cash Flow Amount	n	1/(1+i)^n	PW of Cash Flow	
Construction Cost	$ 81,048.00	0	1	$ 81,048.00	
Cold Milling	$ -	13.95	0.5063	$ -	
Crack Sealing	$ -	4	0.8227	$ -	EUAC
			Total PW	$ 81,048.00	$ 8,208.25

Overlay Thickness = 2.3 inches
Fabric Cost = $ 0.84 /sq. yd.
Life Span = 13.95 Years

c) Untreated (Control) Sections

All Calculations for 1 mile

i =0.05

	Cash Flow Amount	n	1/(1+i)^n	PW of Cash Flow	
Construction Cost	$ 66,211.20	0	1	$ 66,211.20	
Cold Milling	$ -	10.41	0.60175	$ -	
Crack Sealing	$ -	4	0.8227	$ -	EUAC
			Total PW	$ 66,211.20	$ 8,312.86

Overlay Thickness = 2.2 inches
Fabric Cost = No Fabric (Control Section)
Life Span = 10.41 Years

Table 6.4. Life Cycle Cost Analysis: Regression Method Based Upon Predicted Lifespan From Best Fit Trendline, Including Maintenance and Cold Milling Costs

Results for Medium Project Size

a) Sections Treated with Strip Reflective Crack Control

All Calculations for 1 mile

i =0.05

	Cash Flow Amount	n	1/(1+i)^n	PW of Cash Flow
Construction Cost	$ 69,379.20	0	1	$ 69,379.20
Cold Milling	$ 12,249.60	11.52	0.57003	$ 6,982.66
Crack Sealing	$ 2,217.60	4	0.8227	$ 1,824.43
			Total PW	$ 78,186.29

EUAC $ 9,092.11

Overlay Thickness = 2.2 inches
Fabric Cost = $ 0.30 /ln. ft.
Life Span = 11.52 Years

b) Sections Treated with Area-Wide Reflective Crack Control

All Calculations for 1 mile

i =0.05

	Cash Flow Amount	n	1/(1+i)^n	PW of Cash Flow
Construction Cost	$ 81,048.00	0	1	$ 81,048.00
Cold Milling	$ 12,249.60	13.95	0.5063	$ 6,201.99
Crack Sealing	$ 2,217.60	4	0.8227	$ 1,824.43
			Total PW	$ 89,074.42

EUAC $ 9,021.14

Overlay Thickness = 2.3 inches
Fabric Cost = $ 0.84 /sq. yd.
Life Span = 13.95 Years

c) Untreated (Control) Sections

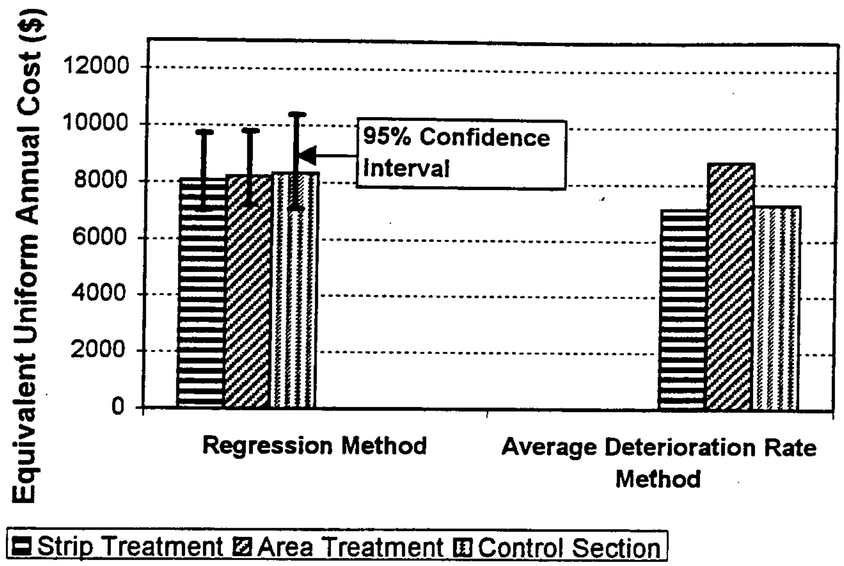
All Calculations for 1 mile

i =0.05

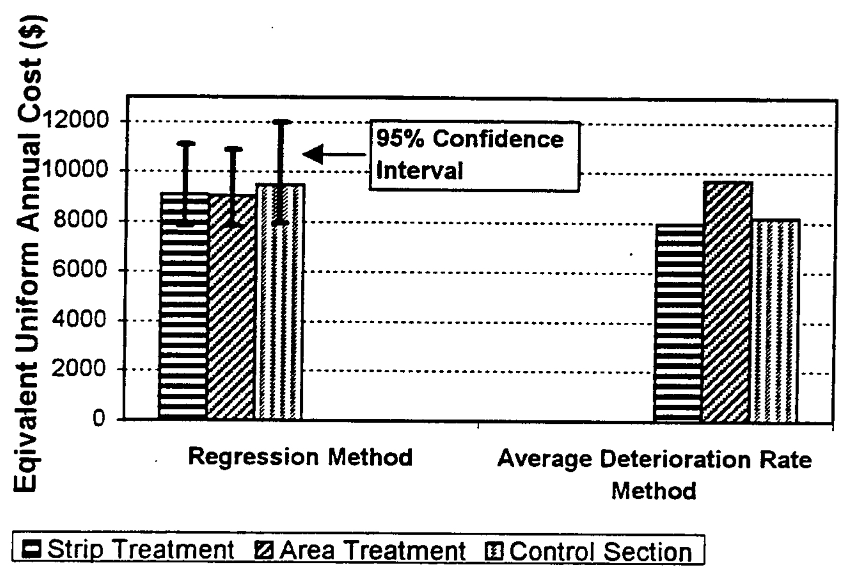
	Cash Flow Amount	n	1/(1+i)^n	PW of Cash Flow
Construction Cost	$ 66,211.20	0	1	$ 66,211.20
Cold Milling	$ 12,249.60	10.41	0.60175	$ 7,371.25
Crack Sealing	$ 2,217.60	4	0.8227	$ 1,824.43
			Total PW	$ 75,406.88

EUAC $ 9,467.39

Overlay Thickness = 2.2 inches
Fabric Cost = No Fabric (Control Section)
Life Span = 10.41 Years

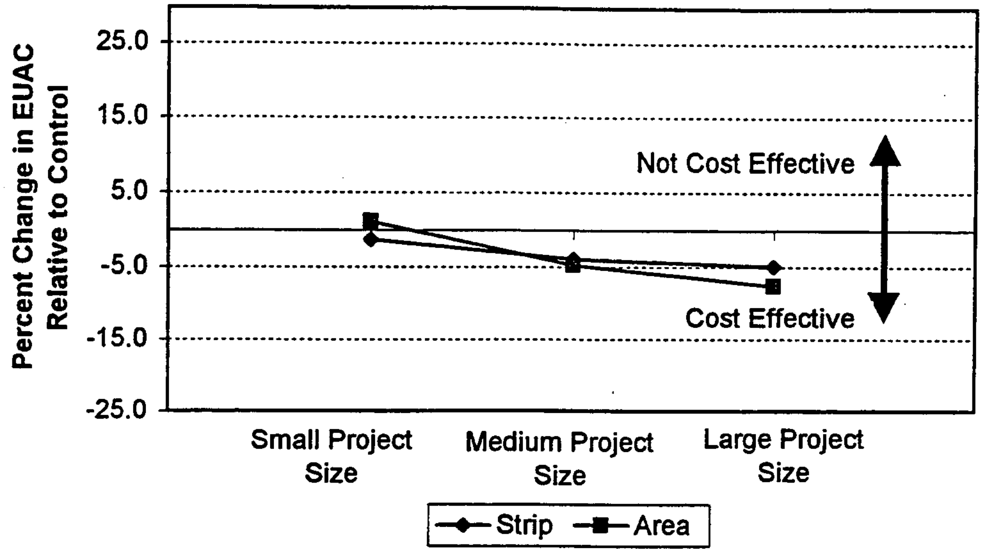


a) Neglecting Maintenance and Milling Costs

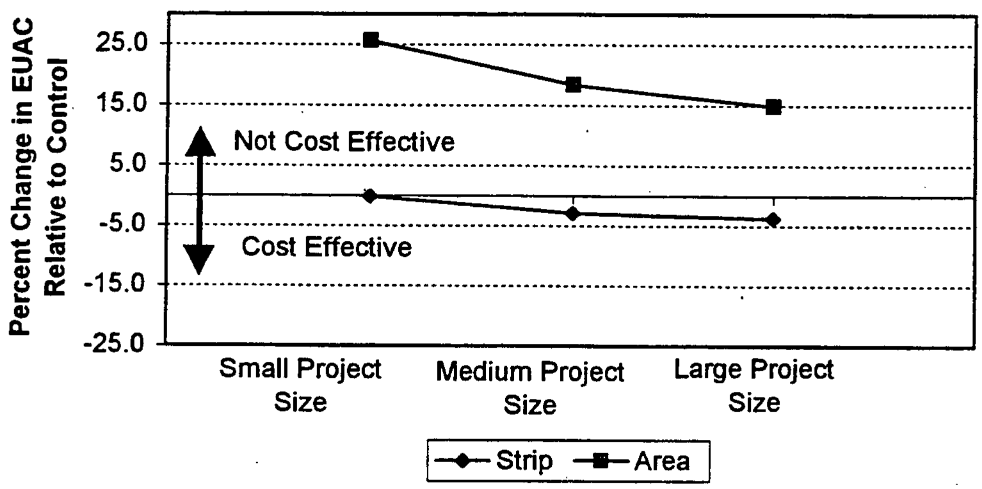


b) Including Maintenance and Milling Costs

Figure 6.5. Life Cycle Cost Comparison for Medium Project Size



a) Regression Method



b) Average Deterioration Rate Method

Figure 6.6. EUAC Comparisons Relative to Untreated Projects, Including Maintenance and Cold Milling Costs

the fewer number of observations available appears to have had a larger impact on the average rate of deterioration method than the regression method. In general, the variability in rate of deterioration can be large for projects of lesser age. This variability has equal weight in the averaged result. On the other hand, the regression method is less sensitive to this variability, since the regression is forced to intercept the y-axis at a CRS value of 9 at zero age, and is therefore more driven by performance of projects with longer performance histories (greater age). Thus, given the limited amount of data available for area and control sections available for this study, the regression method life-span predictions are judged as more reliable inputs for LCCA at the present time.

In summary, strip and area reflective crack control treatments were found to be at a break-even level in terms of life-cycle cost-effectiveness for small projects (1 mile of two-lane road, or less, as described in Section 4.5), increasing to a level of about 6.2% life cycle cost benefit for large projects (6 miles of two-lane road, or greater).

Chapter 7

Permeability Testing

7.1 Overview

A limited study was conducted to evaluate the possible benefits of reflective crack control treatments to provide waterproofing after reflection cracks have appeared in a bituminous overlay. This work was conducted to complement the performance and life-cycle costing results presented in Chapters 5 and 6. For instance, Chapter 5 showed that area reflective crack control did not appreciably retard transverse reflective cracking; however, overall pavement serviceability and predicted life span was superior to that of control sections. This result suggests that the paving fabrics may provide waterproofing benefits even after reflective crack appearance; however it was desired to conduct a forensic investigation to directly measure waterproofing benefits.

Field coring was conducted and a simple laboratory permeability test was assembled. The permeability apparatus was designed to assess the condition of the reflective crack control fabric after the reappearance of reflective cracks, since it is not usually possible to assess fabric integrity and waterproofing benefit by visual inspection after coring. A simple constant head lab permeability test device was constructed to measure the rate of flow of water through cores taken directly on reflective cracks. The apparatus was designed to provide a rapid evaluation of fabric integrity, e.g., to check for substantial fabric tearing and loss of waterproofing benefit.

Due to time constraints in the study, the approach taken was to evaluate pavements that contained areas of moderate to high severity reflective cracking. Thus, if waterproofing benefits were found to remain after severe reflective cracking had occurred in these areas, this would suggest that waterproofing benefit could be expected throughout much of the life of the overlay. If little or no waterproofing benefit was found in the two pavements, then additional pavements with more moderate levels of reflective cracking would need to be tested. The pavements selected for study are summarized below:

Table 7.1 Summary of Projects in Permeability Study

Route/Location	District	Treatment	Base type (below fabric)	Overlay(s)
IL 9–N. Bushnell	4	Area	9" (229 mm) HMA over PCC	1.5" (38 mm) (1989)[1]
				1.5" (38 mm) (1993)
IL 251–Mendota	2	Area	4" (102 mm) HMA over PCC	3" (76 mm) (1995)[1]
IL176–Wauconda	1	Strip	3" (102 mm) HMA over PCC	3" (76 mm) (1988)[1]

[1]Indicates year of placement of fabric and overlay

7.2 Field Coring to Obtain Specimens

Specimens were obtained with a coring rig equipped with a 6-inch inner diameter, water-cooled core barrel, as illustrated in Figure 7.1. Cores were drilled perpendicular to the pavement surface, rather than plumb, to obtain axis-symmetrical cores. Care was taken to minimize damage to the potentially intact fabric layer when removing cores from the barrel once drilling was completed. However, it was often necessary to strike the core barrel with a hammer and force water through the barrel to remove the core. It is not known how damaging these forces are to an intact fabric interlayer, potentially weakened from strains induced by joint movements. However, care was taken to minimize these forces while removing cores.

Once the cores were extracted from the coring barrel, they were labeled and carefully set on the pavement shoulder to dry. Before shipping, the cores were carefully placed in plastic bags and protected by wrapping duct tape around the plastic bags, especially in the vicinity of the fabric interlayer. Cores were taken on transverse and centerline cracks for IL 9, which received area treatment and does not contain a widening joint. Cores were taken on transverse reflective cracks on IL 251, and on reflective widening cracks on IL 176. Pavements were visually examined ahead of coring to locate joints with the highest level of reflective cracking distress for coring.

During coring of IL 9, it was interesting to note that the first core obtained, labeled AT-1, did not have a fabric interlayer within the core. The lack of fabric in this area was not reported anywhere in the plans. The second core obtained, AT-2, was drilled over a transverse joint with very severe reflective cracking and upheaval. This was a joint in unusually poor condition with respect to other joints on the pavement section.

7.3 Development of Permeability Apparatus

A constant head permeability test was developed to determine if there was any leakage through the fabric interlayer within the core specimens (Figure 7.2). Special attention was given to assure that the paving fabric was the only possible drainage path for the water. A reservoir was needed on the top of the specimen to maintain constant head. The bottom of the core required a method to collect the water that passed through the fabric. A 6-in. (152.4 mm) to 4-in. (101.6 mm) rubber bushing with clamp was used as a water reservoir to maintain constant head. Fittings were placed on the "reservoir" so that a constant head of approximately 3-in. (76.2 mm) could be sustained. Another 6-in. (152.4 mm) to 4-in. (101.6 mm) rubber bushing was clamped on the bottom of the core. A funnel was placed inside the bottom bushing so that the water could be transferred to a beaker. A 6-in. (152.4 mm) diameter and 6-in. (152.4 mm) long PVC pipe was used as a stand to stabilize the system.

A clear silicone rubber sealant was applied with a caulking gun to close any vertical cracks on the core surface (Figure 7.3). The sealant was also spread evenly with a brush around the entire side of the core. Clear vinyl sheeting was wrapped around the specimen to assist in working with the silicone sealant and to prevent leakage along the sides of the core (Figure 7.3). Caulking tape was used to prevent leakage of water from the water reservoir. Later it was

Figure 7.1 Field Coring to Obtain Specimens for Permeability Test

Figure 7.2 Constant Head Permeability Test

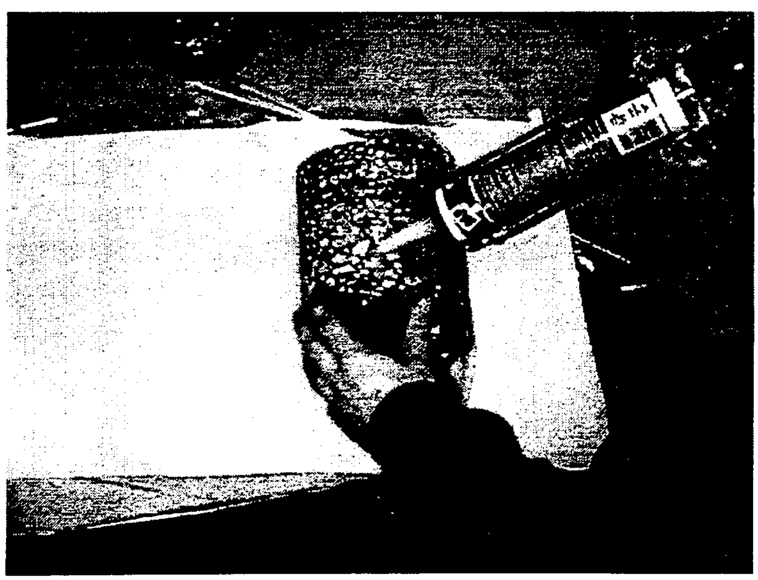


Figure 7.3 Specimen Preparation for Permeability Test

determined that the silicone sealant provided a better seal for the water reservoir, although it was somewhat less convenient to apply.

7.4 Specimen Preparation

The first step in preparing the asphalt core was to cut a piece of vinyl sheeting large enough to be wrapped around the core, leaving enough room so that the vinyl could be folded over the top and bottom of the core. If necessary, the cracks in the core were shimmed with aggregates to avoid closing the crack and possibly buckling the underlying fabric layer upon clamping. The next step was to seal the exposed cracks on the sides of the specimen. After sealing the core, it was placed on its side over the flat piece of vinyl sheeting cut earlier. The silicone rubber sealant was applied in rows about 1-in. apart from each other. The brush was used to spread the sealant evenly over the core's side surface. Once the silicone sealant was spread completely over the sides of the core, the vinyl sheeting was wrapped around the core and adhered to the silicone rubber cement. The vinyl sheeting was smoothed out and used to push out any air voids that may have formed between the sheeting and sealant. A ring of sealant was applied around the crease formed by the asphalt core and the vinyl sheeting. The sheeting was then folded over and pressed firmly against the top of the core. Three or four hours were sufficient time to allow silicone glue to dry. Most specimens were prepared, allowed to dry overnight, and then tested the following day.

7.5 Testing Procedure

After preparation, the asphalt cores were ready to be tested. The rubber bushing with the funnel was first clamped onto the core. The core was placed in the 6-in. (152.4 mm) PVC pipe to stabilize the core. Next, the bushing used as the reservoir was clamped approximately 0.25 in. (6.35 mm) from the surface of the core. A strip of caulking tape or silicone sealant was then placed on the interior edge created by the specimen and the rubber bushing to avoid seepage of water on the outside of the core. A vacuum pump was used to de-air the water source. The de-aired water was allowed to flow into the upper reservoir and out of an overflow tube as necessary to establish a constant head of approximately three inches (75 mm). A 200-ml beaker was placed under the funnel attached to the bottom of the core to measure the water outflow. The test was run 30 minutes for each core and the milliliters of water collected were recorded in 5-minute intervals.

7.6 Results

Tables 7.2-7.4 present the results of permeability tests performed, using the experimental procedures described above. The above results indicate that the paving fabric can have a significant impact in reducing the flow of water even under severe distress. For IL 9 (Table 7.2), two specimens had complete flow restriction provided by the fabric (AT4 and AC2). The cores AT3 and AC1 allowed very minimal amounts of flow through the fabric (<1 ml/min). During testing, the flow through these two specimens was observed as a slow drip.

Table 7.2 Results of Permeability Testing (IL 9)

Core Location (IL 9)	Core Label	Crack type	Volume Permeating (ml in 30 min. test)	Permeability (ml/min) ♦
573 + 10	AT2	Transverse	175	6
573 + 15	AT3	Transverse	6	< 1
573 + 25	AT4	Transverse	0	0
573 + 60	AT5	Transverse	*	---
573 + 65	AC1	Centerline, Longitudinal, Transverse	9	< 1
573 + 66	AC2	Centerline, Longitudinal	0	0

* There was potential damage to the core during handling, as the specimen was inadvertently twisted, causing significant bending on the fabric. Constant head could not be maintained on this core during testing because of the excessive flow rates through the fabric. Excessive flow rates were expected because the bottom of the paving fabric was exposed and two, 3 mm (1/8-in.) holes were noted.

♦ Milliliters of water permeating through fabric per minute.

Table 7.3 Results of Permeability Testing (IL 251)

Core Location (IL 251)	Core Label	Crack type	Volume Permeating (ml in 30 min. test)	Permeability (ml/min)♦
1367+14	C2	Transverse	*	---
1369+77	C3	Transverse	625	21
1373+07	C4	Transverse	1875	63
1435+90	C5	Transverse	18000**	600
1438+40	C6	Transverse	0	0
1542+30	C7	Transverse	9000***	300

* Fabric was completely torn.

** Fabric was visibly strained right above crack.

*** Fabric had puncture failure.

♦ Milliliters of water permeating through fabric per minute.

Table 7.4 Results of Permeability Testing (IL 176)

Core Location (IL 176)	Core Label	Crack type	Volume Permeating (ml in 30 min. test)	Permeability (ml/min)♦
161' east of driveway at J. Van Hoorn 27617 Hwy. 176	C6	Longitudinal	545	18
	C7	Longitudinal	20	< 1

♦ Milliliters of water permeating through fabric per minute.

Permeability testing on IL 251 and IL 176, showed mixed results. Of the eight tests performed on cores from these two locations, only two showed complete waterproofing, and two others leaked at a rate of less than 25 ml/min. The other five specimens showed higher permeabilities, and in some cases, tearing or puncture damage in the fabric interlayer was observed.

7.7 Conclusions and Recommendations

1) The sampling and testing methods developed in the study appear to be suitable for the measurement of permeability in specimens cored over reflective cracks and which contain interlayer fabrics.
2) Testing clearly showed that fabrics can provide waterproofing after reflective cracking occurs.
3) The results should be viewed as a very conservative estimate of waterproofing. The projects selected and locations of coring within each project were intended to represent high severity reflective cracking and the most demanding conditions for the fabrics. Furthermore, it is unknown what extent of damage is incurred by the fabrics during coring and handling.
4) The findings obtained were for a small number of projects and should be viewed as preliminary. Additional testing is needed to clearly understand waterproofing benefits.

Chapter 8

Experimental Sections and Future Monitoring

8.1 Overview

This following items are described in this chapter:

- Layout and Sampling of Experimental Sections
- Experimental Sections Established in this Study
- Recommendations for Future Monitoring of Existing and Experimental Projects

8.2 Layout and Sampling of Experimental Sections

A set of guidelines for layout and documentation of experimental sections was developed, as follows:

Layout Guidelines:

- *Control section(s)* denote the portion(s) of projects *not receiving* reflective crack control treatments. Control sections should ideally be a minimum of 500 feet (150 m) in length. However, urban projects having varying traffic and/or support conditions in short intervals might necessitate a shorter control section length.

- *Test section(s)* denote the portion(s) of projects *receiving* crack control treatment *and* having similar support conditions as the control section. Test sections should also be a minimum of 500 feet (150 m) in length, and should be directly adjacent to control sections, in the same traffic lane. Thus, the layout of control and test sections will normally involve identifying portion(s) of projects of at least 1000 feet (300 m) in length having similar existing pavement condition, traffic, support, drainage, and rehabilitation preparations (rotomilling, etc.) and subdividing the identified portion into test and control sections.

- Test and control sections will have identical overlay course materials and thicknesses, unless special arrangements are made. However, the design and construction of additional pairs of test and control sections on the same project, where each pair of test and control sections has a different total overlay thickness is *strongly encouraged*, whenever possible.

Minimum control section lengths of 500 feet (150 m) are recommended so that reliable comparisons to treated areas can be made. In the typical case of an overlay with a rigid base, control sections shorter than 500 feet (150 m) might not include enough transverse joints to provide a reliable result. If noticeable changes in the existing pavement condition are found within the project, both treated and untreated areas of approximately equal existing condition should be identified and documented.

Recommended guidelines for required documentation of location, stationing of treated and untreated portions, overlay materials and thickness, fabric manufacturer and type, etc., are as follows:

Documentation Guidelines:

- Location/Project Information
  - Route/ Contract/ Project completion date
  - District/ County/ Nearby towns
  - Direction/Lanes included in Experimental Section
  - Stationing limits for Experimental Section(s)
  - Landmarks (if applicable)

- Experimental Section Layout Information
  - Existing pavement type and condition
  - Description of any milling, patching, crack sealing, and other rehabilitation activities prior to placement of paving fabric and overlay lifts
  - Treated Section(s)
    - Station limits
    - Lane(s)/ direction
  - Untreated Section(s)
    - Station limits
    - Lane(s)/ direction

- Overlay and Crack Control Information
  - Total overlay thickness
  - Average thickness of leveling binder (If applicable, estimate range of thickness if known)
  - Asphalt mixture type(s)
  - Asphalt binder grade
  - Fabric system (A, B, or C), placed in strip or area, and fabric brand name/ type/ weight

8.3 Experimental Sections Constructed During the Study

Five experimental projects were recently constructed, and contain carefully planned control sections, as summarized in Table 8.1. Detailed information concerning experimental section location, layout, stationing, and materials can be found in Appendix F. Additional experimental sections are being planned in Districts 4 and 9; including projects with strip reflective crack control. It is recommended that these and other additional experimental sections across Illinois be pursued as a follow-up to those established in this study.

Table 8.1 New Experimental Sections for Evaluation of Reflective Crack Control

Route	Town	County	District	Treatment	Completion
I 474	East Peoria	Tazewell	4	Area	1997
IL 29/US 24	City of Peoria	Peoria	4	Area	1998
IL 29	Mossville to Chillicothe	Peoria	4	Area	1998
IL 40	Deer Grove	Bureau and Whiteside	2	Area	1997
US 34	La Moille and Mendota	Bureau and La Salle	2	Area	1998

8.4 Recommendations for Future Monitoring

Based upon the findings of this study, follow-up monitoring efforts should include:

1. *Continued updating of CRS distresses for projects in the database.* Now that the database has been set up and programmed, additional data can be entered and analyzed with minimal effort. Longer performance histories of projects in the database will lead to a more accurate assessment of benefits of reflective crack control treatments.
2. *Regular crack mapping for new and existing control sections.* For projects containing control sections, it is recommended that crack maps be generated and analyzed on a regular basis to supplement and verify CRS data. If a previous cracking map exists, it should be updated by simply extending cracks and modifying crack widths as necessary. Crack widths should be reported in millimeters, and measured to the nearest millimeter. If mapping on a new form, sketch all visible cracks on the form, noting the approximate crack widths, as described above. Mapping once per year, preferably in early spring after winter cracks have appeared and remain open, would be very beneficial.

3. *Additional experimental sections are needed, particularly for strip reflective crack control treatment*. Five experimental sections with area-wide reflective crack control treatment were started and/or completed in 1997. Additional projects, particularly with strip reflective crack control are needed to very clearly distinguish performance of treated and untreated sections.
4. *Additional coring and permeability testing is needed to assess waterproofing benefits more completely.* As summarized in Chapter 7, additional testing is needed, particularly for strip treatments, to gain a more thorough understanding of the waterproofing capacity of interlayer fabrics even after reflective cracks have formed. These projects should also be re-cored and tested periodically to study trends in waterproofing versus age of overlay.

Chapter 9

Summary, Conclusions, and Recommendations

9.1 Summary

The key findings of this study can be summarized as follows:

- By surveying each of the nine IDOT districts, projects identified as having reflective crack control treatments had the following characteristics:
  - Most of the projects in this study were judged as having rigid bases, although in many cases they were reported as having flexible bases when a bituminous overlay was present at the time of rehabilitation with reflective crack control treatments.
  - Approximately 93 percent of projects identified were reported to utilize IDOT reflective crack control system A.
  - Most of the projects identified involved the placement of an overlay with a total thickness in the range of 1.5 to 3.0 inches (38 to 76 mm) in conjunction with the fabric interlayer. The placement of the fabric within the overlay varied. A typical arrangement involved sandwiching the fabric between a 0.75-inch (19-mm) leveling binder course and 1.5-inch (38-mm) surface course. However, fabric was placed directly on an existing, rotomilled bituminous overlay surface for 38 percent of the projects surveyed.
- Significant variation was found to exist in the installed costs of both strip and area-wide reflective crack control systems. However, project size accounted for a large part of this variation. The average installed cost of fabrics in projects categorized as small (about 1 mile of two-lane pavement, or less) was approximately twice as costly as that of large projects (about 6 miles of two-lane pavement, or greater).
- For eight projects identified as having control sections (untreated portion(s)), crack maps were obtained, which allowed side-by-side comparisons of treated and untreated sections under similar conditions to be made. While only three of the eight control sections have experienced appreciable reflective widening crack development to date, measured reflective widening cracks were substantially retarded in each of these three sections (two treated with strip and one with area-wide reflective crack control treatment). The benefit

of fabrics in the mitigation of measured transverse cracking was found to be minimal in these eight sections.

- In performance comparisons drawn from the entire database and utilizing CRS distress levels, differences between distress levels in treated and untreated portions were found to be negligible.

- Conversely, overlay life spans were predicted to be increased when paving fabrics were used, based upon overall CRS serviceability ratings. Predicted overlay life spans of 11.5, 14.0, and 10.4 years, for strip-treated, area-treated, and control sections were obtained, based upon linear extrapolation of CRS-rating-versus-overlay-age relations to a rehabilitation trigger level of 5.0. It should be noted that a significant amount of extrapolation was required to reach these estimates for projects treated with area-wide reflective crack control. Strip-treated projects required the least amount of extrapolation and are considered to be the most reliable. Confidence intervals were computed and plotted to quantify the uncertainty in the predictions.

- The fact that area-treated projects showed little retardation of transverse reflective crack growth, yet showed benefits in terms of reduced loss of overall serviceability with respect to untreated sections was not a surprising result. Previous studies have shown that reflective crack control systems such as IDOT System A will permit transverse reflective cracking to appear as early as the first winter. Cracks invariably develop because thermal tensile stresses can be very large in the direction of traffic, and because vertical movements at transverse joints in PCC pavements under heavy truck loads combine with environmental stresses to propagate reflective cracks quickly. However, as shown in Chapter 7, waterproofing benefits can be realized long after reflective cracks appear. This waterproofing benefit appears to substantially reduce the rate of serviceability loss in projects treated with area-wide reflective crack control.

- Life-cycle cost analyses showed strip and area reflective crack control treatments to be marginally cost effective. Cost-savings ranged from a break-even level in terms of life-cycle cost-effectiveness for small projects (about 1 mile of two-lane pavement, or less), increasing to a level of about 6.2% life cycle cost benefit for large projects (about 6 miles of two-lane pavement, or greater). However, due to the uncertainty of life span predictions, differences in life cycle costs of treated and untreated sections were found to be statistically insignificant.

- A much better assessment of performance benefits will be possible in approximately two to three years as the performance database matures. The amount of extrapolation required to predict terminal serviceability levels will be reduced, and confidence intervals will become narrower.

9.2 Conclusions

The key conclusions of this study can be summarized as follows:

- There is no statistical difference between the life-cycle costs of strip- or area-treated projects relative to untreated projects (those not receiving crack control). This conclusion pertains only to IDOT reflective crack control system A used over rigid bases.

- However, based upon currently available performance data, strip and area reflective crack control treatments appear to be marginally cost effective. Life cycle cost savings were estimated at a breakeven level for small projects (about 1 mile of two-lane pavement, or less) and 6.2 percent for large projects (about 6 miles of two-lane pavement, or greater).

- No conclusions can be drawn concerning the cost-effectiveness of reflective crack control systems B and C, as their use in Illinois was found to be minimal over the past 20 years.

9.3 Recommendations for Further Research

- The database developed in this study should be updated periodically, according to the procedures outlined in this study. The additional data available in just two to three years will greatly reduce the amount of extrapolation required to estimate useful overlay life span, particularly for projects treated with area-wide reflective crack control and control sections. The additional data collected will greatly improve the reliability of assessing the benefits of reflective crack control systems, which will in turn lead to more accurate assessments of the cost effectiveness of these systems. Furthermore, at that time some of the new experimental sections developed during this study will be approaching four years in service, allowing side-by-side performance comparisons under relatively controlled study conditions to be evaluated.

- IDOT policy allows a reduction of pavement patching prior to the placement of a bituminous overlay in exchange for greater overlay thickness. Additional research is needed to assess the performance and cost-effectiveness of this rehabilitation strategy.

- Additional research is needed to assess the performance and cost-effectiveness of IDOT reflective crack control systems B and C.

- Additional control sections should be developed according to the guidelines set forth in this study. This will also lead to more accurate assessment of the cost-effectiveness of reflective crack control treatments in the future.

- A better understanding of the mechanisms of reflective cracking is still needed. Additional study should be conducted to better understand such critical issues as overlay thickness, physical properties of overlay mixtures, and optimal placement of fabrics within the overlay lifts.

- Additional research is needed to evaluate waterproofing benefits for a wider range of field installations involving area treatment. Further studies should seek to better define the long-term benefits of such a moisture barrier.

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Appendix A

(Project Identification Survey)

Table A1. Project Identification Survey Results: District 1

District 1							
IDOT Crack Ctrl Sys	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Compl-tion Date	Qty	Possible Control Sections
A	S	F	Thatcher Ave from North Ave. to 1st Ave. in River Grove, IL	60016	11/96	7000 lf	No
A	A	F	Wolf Rd. from North Ave. to Withers in Northlake, IL	60088	late 6/97	45000 sy	No
		R	I-355, Army Trail Rd. to US-20	80162	8/6/90		No
A	S	R/F	IL-59, 111th to 127th	82855	8/13/96		No
A	S	F	US Rte 45 from Winchester Rd. to IL Rte 120, widening, both sides	82845	11/95	13000 lf	No
A	S	F	IL Rte 120 @ Mill Rd., widening, both sides	82471	5/15/97	11703 lf	No
A	S	R	I-290 from 355 N-S Tollway to Thorndale				No
A	S	R/F	Rte 12 Volo to Fox Lake	80677	1991	80000 lf	No
A	S	F	Rte 176 Wauconda to Mundelein	80238 80230	1989	Many miles	No
A	S	F	Rte 12 (old Rand Rd) Wauconda	34005	1980		No
A	S	R	Rte 176 in Island Lake Project, No asphalt work	82913	7/97		No
B	S	R	IL-64 resurfacing I-290 to IL-43, Mill 2-1/4" (Place 2-1/24" surf cse "E")	80903	8/27/93	7775 lf	No
B	S	R	Higgins Rd, west bound lane, west of Arlington Hts. Rd., lanes 1, 2, 3 and left and right turn lanes, lane widening.	80635	10/31/96	5685 lf	No
B	S	R	Arlington Ht Rd. - south bound. From I-90 to south of Higgins, lane 1 & 2. Lane widening.	80635	10/31/96	12350 lf	No
B	S	R	Arlington Ht. Rd. N. Rd. from I-90 to south of Higgins. Lanes 1 & 2. Lane widening	80635	10/31/96	17354 lf	No

Table A2. Project Identification Survey Results: District 2

District 2							
IDOT Crack Ctrl Sys	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Compl-tion Date	Qty	Possible Control Sections
A	A	R	IL-81 W, of Kewanee. McNeill Asphalt	64048	10/96	9752 sy	No
A	A	R	IL-40 in Sterling. Northwest IL Construction.	64045	10/96	4488 sy	No
A	S	R	IL-64 E. of Oregon. Bob Propheter Construction.	64125	10/96	2721 lf	No
A	S	R	IL-70 S. of Durand. Rockford Blacktop Const.	64126	9/96	10901 lf	No
A	A	R	IL-251 S. of Rochelle. Bob Propheter Const.	64131	10/96	85996 sy	No
A	A	R	IL-251 N. of US-30. B. Propheter Const.	84995	11/95	67269 sy	Yes
A	S	R	IL-23 in DeKalb. Alliance Contractors	84997	6/96	17231 lf	No
A		R	US-34 / IL-78 in Kewanee. McNeill Asphalt	84947	10/95		No
A	S		Crosstown - E. Moline. Valley Construction Co.	84923	7/96	10221 lf	No
A	S	R	I-80 IL-26 E. 19 mi. Advanced Asphalt & B. Propheter	84837	11/95	586 sy 193457 lf	No
A	S	R	I-80 Princeton W - 10 mi. B. Propheter & McNeill Asphalt	84832	11/94	61842 lf	No
A	S/A	R	IL-29 from IL-26 to IL-89. Grayfield Construction	84797	10/96	5719 lf	No
A	S	R	US-150 N. of IL-81. Valley Construction	84785	11/96	8358 lf	No
A	A	R	IL-26 N. of Cedarville. Civil Constructors	84795	11/95		No
A		R	I-80 E. of IL-40. Advanced Asphalt & B. Propheter	84706	11/94		No
A	A		IL-2, Dixon-Grand Detour. B. Propheter Construction.	84378	7/95	482 sy	No
A	S		IL-76, Belvidere-Wisc. Rockford Blacktop.	84469	7/96	97513 lf	No
A	S	R	IL-92 in E. Moline. Brandt construction Co.	84484	7/96	10250 lf	No
A	S		IL-40, Sterling-Milledgeville. Advanced Asphalt Co.	84493	10/94	6763 lf	No
A	S		IL-26, Princeton-Bureau Jct. Advanced Asphalt Co.	84509	11/95	20808 lf	No
A	S		US Bus. 20 @ Mulford. Rockford Blacktop	84579	6/96	21420 lf	No
A	S		Ogdan Ave. in Geneseo. Valley Construction Co.	84681	11/96	11232 lf	No
A	S		US-6 and 34, Sheffield, to IL-40.	84698	08/96	30381 lf	No

District 2							
IDOT Crack Ctrl Sys	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con- tract #	Compl- tion Date	Qty	Possible Control Sections
			McNeill Asphalt Co.				
A	S		US-20, Galena to Mt. Hope Rd. Civil Constructors, Inc.	84699	10/96	12416 lf	No

Table A3. Project Identification Survey Results: District 3

District 3							
IDOT Crack Ctrl Sys	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Compl-tion Date	Qty	Possible Control Sections
A	S	R	FAS 256 (106, 107, 108) W & RS LaSalle County on Rte 178 at the I-80 interchange, North of Utica	86102	9/17/90	42508 lf	No
A	S	R	FA 619 103 W & RS, LaSalle County. Bit. Base course widening and resurf on IL-71 near Cedar Point	86199	12/13/91	94231 lf	No
A	S	R	FA 41 (14, 15) RS-2, Livingston county. 8.08 miles of resurf. And bridge deck repairs on IL-17	86230	10/22/91	125950 lf	No
A	S	R	FAS 2370 (1G, 18CS) RS, (3) RS-1. Widening and resurf. On IL-26 from south of IL-17 to IL-18 north of Lacon	86198	09/30/91	61147 lf	No
A	S	R	IL-178 from IL-71 southeast of Oglesby south to Lowell	86102	9/17/90	42117.5 lf	Yes
A	A	R	FAS 478 91-00113-02-RS McLean County, 5.2 mile RS and AG6, SHLDS on Towanda Rd. from IL-9 to Towanda	87045	10/06/92	72670 sy	No
A	A	R	FA 681 116 RS and 117 RS-1, Iroquois county. Resurfacing on IL-116 between the Ford-Iroquois county line and Ashkum	86139	11/13/91	84267 sy	No
A	A	R	FAS 323, [(5,68,69,104,116) - 15D] Iroquois County. Rehab. Woodland Rd. from IL-49 to west edge of Woodland.	86221	7/2/92	12614 sy	No
A	A	R	FA 730 Alt. (56A, *CS)RS-1 McLean County. Milling and resurf. On US-51 NB in Bloomington.	86266	1/15/92	14803 sy	No
C	S	R	FA 653 (105,106)RS-1, LaSalle County. 10.9 mi. bit. Concrete resurf. on IL-18 south of Lostant	86202	7/19/91	57552 lf	No
C	S	R	FA68 (103,104,105)RS-2 Livingston Co., IL-23 from Cornell to Pontiac.	86206	10/10/91	75135 lf	No
C	S	R	FA 693 (120,128,129)RS McLean County. Cold milling and resurf. On IL-9 - IL-122 to IL-150 west of Bloomington.	86278	11/5/91	61400 lf	No
C	S	R	FA 46 (70,67,68)RS-4, LaSalle County. Cold mill and bit. Concrete surfacing on US-51 south of IL-18 to south of IL-71.	86317	8/16/93	105074 lf	No

Table A4. Project Identification Survey Results: District 4

District 4							
IDOT Crack Control System	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Compl-tion Date	Qty	Possible Control Sections
A	A	F	Princeville east to E. intersection of IL Rte 90 & 91.	88353	9/27/95	67634 sy	No
A	A	F	IL Rte 91 from Princeville west to IL Rte 78	88089		113449 lf	No
A	A	F	IL Rte 91	88566	8/22/94	3007 sy	No
A	A	F	IL Rte 17	88271	5/22/96	141142 sy	No
A	A	F	IL Rte 29 from Chillicothe N. to S. Parkland	88152	11/24/92	84201 lf	No
A	A	F	IL Rte 40	88211	10/10/96	93,086 sy	No
A	A	F	US Rte 150	88621	10/19/95	150333 sy	No
A	S	F	IL Rte 29, Henry south	88151	10/29/93	58067 lf	No
A	A	F	US Rte 67	88262	6/15/95	26896 sy	No
A	S	F	IL Rte 98	88432	7/29/93	11796 lf	No
A	A	F	IL Rte 122	88678	10/1/96	49961 m^2	No
A	A	F	US Rte 67	88498	9/12/96	23955 m^2	No
A	S	F	IL Rte 41 & 9	88183	5/28/91	40416 lf	No
A	S	F	IL Rte 90	88155	7/27/92	27451 lf	No
B	S	F	IL Rte 40	88406	10/28/93	1838 lf	No
A	A	F	IL Rte 17 & 180	88195	10/19/93	102963	No
A	S/A	F	IL Rte 94 & 17	88205	5/5/93	63385 sy	No
A	S	F	Jackson St. in Morton, IL	88087	5/13/92	24406 lf	No
A	S	F	IL Rte 9	88114	10/17/91	70769 lf	No
A	A	F	IL 65 (Lincoln Ave.)	88420	8/5/93	5683 sy	No
A	S		FAI 74	88180	10/12/91	23041 lf	No
A	S	F	IL Rte 41	88425	7/29/93	3552 lf	No
B	S	R	US-67 E. Jct. W. 136 & Prarie St. in Macomb, 5 lane section	40914		28962 lf	No
A/B	S	R	Pioneer Parkway to IL-6, 5 lanes	38823		7370 lf	No
A	A	F	First installation in Dist. 4. 1 mile length & Area Crack Control placed on Flexible Base	40229		25820 sy	Yes
A	A	R	System A Area Crack Control placed on sag verticle curve.	88019			Yes
A	A	F	US-24 Banner to Little America FA63	88054			No
A	S	F	US-24 Little America to Lewistown FA63				No
A	A	R	US-24 Orchard ? to Kingston ? , 2 lanes only				No

Table A5. Project Identification Survey Results: District 5

District 5							
IDOT Crack Control System	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Compl-tion Date	Qty	Possible Control Sections
A	S	R	FAI-74 & Bit approaches to Mattis Ave. Bridge, Champaign	90095	7/12/93	829 ft	No
A	S	F	IL Rte 1 from Newell Rd. to Liberty Lane in Danville	90106	11/7/94	5094.2 ft	No
A	S	F	IL Rte 1 from Newell Rd. to Rossville	90111	9/15/95	3456 ft	No
A	S	R	Rest areas west of Farmer City - FAI-74	90119	9/8/95	870 ft	No
A	S	F	I-74 & US-45 interchange (Cunningham Ave.) in Urbana)	90121	10/31/92	4000 ft	No
A	S	R	I-74 & Neil St. interchange in Champaign	90122	10/30/92	400 ft	No
A	S	F	Bowman Ave. Bridge & I-74 from IL Rte 1 to Indiana State Line east of Danville	90216	3/31/95	1099 ft	No
A	S	R	North Vermilion St. in Danville, from Fairchild to Winter St.	90239	11/30/95	2937 ft	No
A	S	R	Mattis Ave from Bloomington Rd to Springfield Ave. in Champaign	90256	6/3/94	3242 ft	No
A	S	F	US-45 from Savoy to Tolono	90274	Not completed	15105 ft	No
A	S	F	Il Rte 1 from Belgium to Clingan Ln.	90277	Not completed	3222 ft	No
A	S	R	Bloomington Rd., Champaign, between Mattis Ave. & Prospect Ave.	90328	12/27/95	2099 ft	No
A	S	R	Hungry Hollow Rd., west of Danville	90389	Not completed	8328 ft	No
A	S	R	Leverett Rd. from Market St. to US Rte 45	90405	10/96	7971 ft	No
A	S	F	IL Rte 32 (Hamilton St.) from IL Rte 121 Township Rd. 131 & IL Rte 32 Spur (W. Harrison St.) from Market St. to IL 121 in Sullivan	90416	11/18/96	1213 ft	No
A	S	R	IL Rte 32 Lovington to North of LaPlace	90420	9/12/96	31200 ft	No
A	S	R	IL Rte 10 Clinton to Weldon	90428	12/14/95	12334 ft	No
A	S	R	Montrose Rd. from IL Rte 121 south to Cumberland/Effingham Co. Line	90441	10/26/95	37006 ft	No
A		R	IL Rte 130 @ Westville Rd.	90453	Not completed	18334	No
A	S	R	IL Rte 130 from Camargo to Philo	90527	9/27/95	211635 ft	

District 5							
IDOT Crack Control System	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Compl-tion Date	Qty	Possible Control Sections
A	S/A	R/F	I-57 Tuscola to Arcola	90535	Not completed	467 ft	No
A	S	R	Rte 136 west of I-57	90539	7/29/96	993 ft	No
A	S	F	IL Rte 16 - Windsor to 33rd St. in Mattoon	90562	11/9/94	14121 ft	No
A	S	R	FAP 326 Ford Co. Line to I-74 @ Mahomet	90586	Not completed	3456 ft	No
A	S	F	IL Rte 130 Greenup to Jasper Co. Line	90595	3/14/96	12000 ft	No
A	S	R	US-136 Rantoul to Clifford	90627	7/1/96	1444 ft	No
A	S	F	US-51 in Decatur from Ash Ave. to Karen Dr.	90798	1/4/97	1333 ft	No
A	S	F	IL Rte 1 South of Georgetown	90850	9/13/96	736 ft	No

Table A6. Project Identification Survey Results: District 6

District 6							
IDOT Crack Control System	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Compl-tion Date	Qty	Possible Control Sections
A	A	F	FAS Rte 461 from Manito southwesterly to 1 mile NE of Forest City	93168	8/7/95	31365 sy	
A	A	F	Chesnut Street from 8th-12th street in Quincy	93061	1/26/93	7851 sy	
A	S	F	IL-121 from Mt. Pulaski to the Macon Co. line.	92816	11/23/94	59636 lf	No
A	A	F	Old US-66 from IL-10 in Lincoln to Salt Creek south of Lincoln	92766	8/24/95	12771 sy	Yes
A	S	F	IL-104 from the west limits of Bulpitt to IL-29 at Taylorville	92757	11/21/94	68928 lf	No
A	A	F	IL-48 to Cheney St. in Taylorville	92696	10/2/96	36216 sy	No
A	S	F	IL-78 from the east branch of the Illinois River in Bath to Saidora Rd.	92476	11/27/95	61144 lf	No
A	S	F	IL-123 from 97/123 Junction to IL-125 west of Pleasant Plains	92458	6/28/96	97466 lf	No
A	S	F	US-136 from 2-1/2 miles east of Havana and extending east 4-1/4 miles	92444	3/23/95	64865 lf	Yes
A	S	F	US-24 from TR600N northerly to Rushville	92440	6/28/93	62619 lf	No
A	S	F	IL-185 from 3 mile east of Coffeen to the Fayette Co. line.	92432	5/29/95	49420 lf	No
A	S	F	IL-123 from 1 mile east of Petersburg to IL-29	92382	3/30/96	66983 lf	No
A	S	F	IL-106 from 1-1/4 miles N. of Alsey southerly to the Scott-Greene Co. Line.	92378	12/2/94	47812 lf	No
C	S	F	IL-100 from IL-106 in Detroit to e/r mile south of Milton	92295	11/23/94	51312 lf	
A	S	F	IL-96 from the Adams-Hancock Co. Line northerly 10.8 miles	92274	6/28/96	168499 lf	No

Table A7. Project Identification Survey Results: District 7

District 7							
IDOT Crack Control System	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Compl-tion Date	Qty	Possible Control Sections
A	S	F	FA-327 (Rt.50) west of Salem	94053	10/26/94	4441 lf	No
A	S	F	IL Rt.1 approx. 1 mi. south of Carmi	94054	8/24/94	3350 lf	No
A	S	F	IL Rt. 1 approx. 1/2 mi. south of Carmi	94109	6/21/95	1461 lf	No
A	S	F	IL Rt 15 from 1/2 mi. west of Mt. Vernon to Mt. Vernon	94136	10/22/93	4737 lf	No
A	S	F	IL-15 at west edge of Wayne City	94173	4/25/94	13450 lf	No
A	S	F	IL-130 between Mack Ave. and CXT RR in Olney	94220	9/17/93	15110	No
A	S	F	IL-33 north of Willow Hill	94255	6/30/94	38614 lf	No
A	S	F	FAI-57 & 64 at North Tri-level @ Mt. Vernon	94270	7/20/94	19681 lf	No
A	S	F	FAI-70 from Bond Co. line to Rt 40 interchange at Vandalia	94282	5/16/94	2916 lf	No
A	S	F	IL Rt 161 east of Centralia	94331	9/16/93	7553 lf	No
A	S	F	IL Rt 142 from McLeansboro to Ham-Saline Co. line	94359	6/12/95	102322 lf	No
?	?	?	FAI-57 (NB) from Edgewood to north of Watson	94389	8/19/96	1282 lf	No
A	S	F	FAI-70 west of Vandalia to east of Kaskaskia River	94423	7/20/94	3071 lf	No
A	S	F	US-40 in Vandalia from 185 to 51	94427	9/21/94	2084 lf	No
A	S	F	US-45 from Geff to US Rt 50	94435	8/19/94	46190 lf	No
A	S	F	US-45 from Flora to US Rt. 50	94554	1995	15077 lf	No
A	A	F	FAS-806 Bridgeport Road	95135	1994	73333 sy	No
A	A	F	FAS-819 Texico Road, Texico to CH2	95153	1994	45402 sy	No
A	A	F	FAS-822 Mt. Vernon Rd. - FAS-819 to 820	95154	1994	69598 sy	No

Table A8. Project Identification Survey Results: District 8

District 8							
IDOT Crack Control System	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Compl-tion Date	Qty	Possible Control Sections
	S	R/F	IL Rte 106 from IL Rte 267 in Whitehall to the Scott Co. line.	96229	7/20/90	58924 lf	No
	S	R	IL Rte 203 from Big Bend to Alexander Streets in Madison & Granite City	96514	8/16/94	18491 lf	No
	S	F	IL-159 from north at I-55/70 to IL Rte 162 in Maryville	96314	1991	11371 lf	No
	S	F	IL-4/150 from east of Perry-Randolph Co. line to Steeleville City limits	96403	1992	43500 lf	No
A	S	R	IL-158 Millstadt to Douglas Rd.	96155	3/91	31680 ft	No
A	S	R	IL-163 Millstadt to Centreville	96238	8/90	69000 ft	No
A	S	R	IL-156 Waterloo to Hecker ADT 3000	96239	6/90	93000 ft	No
A	S	R	IL-156 Valmeyer to Waterloo	96272	8/91	101900 ft	No
A	S	R	IL-158 Millstadt to Belleville	96273	8/91	50787 ft	No
B	S	R	IL-203 City of Madison	96142	6/93		No
A/B	S/A	R	IL-111 from Pontoon Rd. to Chain of Rocks Rd. in Pontoon Beach	96539	1994		Yes
A	S	R	IL-203 from Madison Ave. to Pontoon Road in Granite city	96388	7/92		No
?	S	R	IL-111 from Rosemont to Hill Ave. in Washington Park	42312	1990	10700 ft	No
A	S	R	IL-127 from US-40 to US-50	96555	10/93	260389 lf	No
A	S	R	IL-4 from I-70 to US-50	96821	10/94	97838 lf	No
B	S	R	IL-127 (3rd st.) in Greenville Main Street to College	96671	11/95	60 lf	No
A	S	R	IL Rte 4/150 from Steeleville to Percy	96403	2/93	43500 lf	No
A	S	R	IL Rte 4/13 from Marissa to Tilden	96384	3/94	60000 lf	
A	S	R	IL Rte. 150 from Chester to Rte 4	96660	9/94	84702 lf	No
A	S	R	IL-159 in Collinsville from Angle St. (by Brooks Water Tower) north to Illinois st.		5/89		No
A	S	R	IL-140 from IL0160 east for 11 miles		11/89		No
A	S	R	Il-4 from I-64 north to Lebanon (RR crossing at south end of town)		6/90		No
A	S	R	IL-160 from Highland to Trenton		Fall '90		No
A	S	R	IL-157, 0.75 miles north of FAI 55/70 section 1.4 miles in length		Fall '91		No

District 8							
IDOT Crack Control System	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Compl-tion Date	Qty	Possible Control Sections
A	S	R	FA-600 (IL Rte.159) from IL Rte.161 in Belleville to south of Lincoln Highway in Fairview Heights	96198	10/14/90	40000 lf	No
A	S	R	US Rte 51 from IL Rte 15 (at Ashley) to one mile south of the county line in Perry Co.	96417	12/03/92	7400 lf	No
A	S	R	IL Rte 177 from Irvington to US Rte 151	96286	6/19/91	7400 lf	No
A	S	R	Old Rte 50 from the St. Clair Co. line to Trenton in Clinton Co.	96288	11/02/90	23200 lf	No

Table A9. Project Identification Survey Results: District 9

District 9							
IDOT Crack Control System	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con-tract #	Date Let	Qty	Possible Control Sections
A	A	R	IL-146 Widen and Resurface	98126	10/11/91	29340 sy	No
A	A	R	IL-13 from Fair St. to Old Rt. 13	98193	1/14/94	21098 sy	No
A	A	R	IL-13 Section (6Z)R	98194	5/6/96	20620 sy	No
A	A	R	IL-166 from Creal Springs to US-45	98196	1/14/94	68168 sy	No
A	A	R	IL-13 in H'burg and US-45 in Eldorado	98199	5/20/94	30400 sy	No
A	A	R	IL-13 in Marion and various	98201	7/10/92	18458 sy	No
A	A	R	IL-151 from IL-3 to IL-4 in Ava	98210	1/14/94	9629 sy	No
A	A	R	US-51 Middle Relocation in Union Co.	98278	10/06/95	12234 sy	No
A	A	R	IL-13 DeYoung St. in Marion	98282	4/12/96	10575 sy	No
A	A	R	Old IL-13 in Marion (Main St.)	98286	7/12/96	12600 sy	No
A	A	R	Barnett St. realignment in H'burg.	98325	4/14/95	1389 sy	No
A	A	R	Various: IL-154, 146, 169 and US-45	98333	8/26/94	22837 sy	No
A	A	R	IL-142 from Eldorado to IL-13	98338	7/7/95	4446 sy	No
A	A	R	IL-13 in Marion and IL=37 in Mounds	98360	8/25/95	14688 sy	No
A	A	R	RS 4 locations in D09 (IL-13)	98402	8/30/96	23630 sy	No
A	S	R	IL-146 from Hardin Co. to Golconda	98126	10/11/91	93023 lf	No
A	S	R	IL-148 from Jeff Co. line to N. City	98129	10/02/92	69480 lf	No
A	S	R	IL-14 Relocation thru Old DuQuoin	98146	2/25/94	13447 lf	No
A	S	R	IL-13/127 from Ind. Park Drive north	98187	2/24/95	12449 lf	No
A	S	R	RS three locations in Dist.9	98199	5/20/94	22125 lf	No
A	S	R	IL-151 from IL-3 to IL-4	98210	1/14/94	74978 lf	No
A	S	R	IL-34 from Benton to Galatia	98225	5/20/94	254168 lf	No
A	S	R	6 locations on IL-14, IL-13, and US-51	98227	5/20/94	28765 lf	No
A	S	R	Bit. Resurf on Us-51 and IL-127	98228	4/8/94	6830 lf	No
A	S	R	FD on IL-13 from IL-166 to Co. Line	98230	7/1/94	34000 lf	No
A	S	R	US-51 rel. from IL-146 south	98234	5/19/95	4437 lf	No
A	S	R	IL-146 from Pope Co. to Golconda	98240	7/2/93	199917 lf	No
A	S	R	IL-13 @ Crab Orchard Crk. Bridges	98248	7/1/94	2635 lf	No
A	S	R	RS at 8 locations in D-9	98255	2/25/94	39666 lf	No
A	S	R	Bridge on US-51 N. of C'dale	98266	5/19/95	900 lf	No
A	S	R	IL-1 from IL-13 to Omaha	98268	11/22/96	56970 lf	No

District 9							
IDOT Crack Control System	(S)trip or (A)rea	(R)igid or (F)lexible	Description	Con- tract #	Date Let	Qty	Possible Control Sections
A	S	R	RS 5 locations on IL-127 and 146	98269	6/10/94	18600 lf	No
A	S	R	IL-149 in W.F. and IL-37 in Marion	98274	5/20/94	85588 lf	No
A	S	R	IL-13 in marion-DeYoung St.	98282	4/12/96	3670 lf	No
A	S	R	US-45 in Metropolis	98288	5/20/94	34751 lf	No
A	S	R	IL-3 and IL-146 near the Cape T	98311	8/26/94	4500 lf	No
A	S	R	IL-146 in Anna	98327	5/17/96	2563 lf	No
A	S	R	RS four locations in Dist. 9	98333	8/26/94	15834 lf	No
A	S	R	IL-142 from IL-13 to Eldorado	98338	7/7/95	97717 lf	No
A	S	R	RS Various Loc. In D-9	98339	7/7/95	111028 lf	No
A	S	R	IL-169 near Karnak	98355	5/19/95	11000 lf	No
A	S	R	IL-13 in Marion & IL-37 in Mounds	98360	8/25/95	2982 lf	No
A	S	R	Herrin St. west of Herrin	98388	8/30/96	28072 lf	No
A	S	R	IL-127 north of Pinckneyville	98390	8/30/96	900 m	No
A	S	R	US-51 north of Cairo	98391	8/30/96	6808 m	No
A	S	R	IL-148 south of Herrin	98400	8/30/96	13696 m	No
A	S	R	RS 4 locations in Dist 9 (IL-169)	98402	8/30/96	17400 lf	No
A	S	R	Bay City Rd. near Golconda	99054	7/7/95	2929 lf	No
A	S	R	Mill St. Extension in Carrier Mills	99062	8/25/95	250 lf	No

Appendix B

(Second Surveys - Final 52 Projects)

Table B1. Second Survey (Final 52 Projects) - Strip Treatment

Contract#	District	Zone	Date Let			Job Description	Date Completed		
			Month	Date	Year	Brief Job Description	Month	Date	Year
34005	1	1				Route 12 (Old Rand Rd.) Wauconda			80
80230	1	1				Route 176 Wauconda to Mundelein			88
80238	1	1				Route 176 Wauconda to Mundelin			89
80677	1	1				Route 12 from Volo to Fox Lake			91
82845	1	1				U.S. Rte. 45 from Winchester Rd. to IL Rte 120. Over existing widening on both sides.	11		95
84509	2	1				IL Rte. 26, Princeton to Bureau Juntion. Advanced Asphalt Co.	11		95
84832	2	1				I-80 Princeton W - 10 mi. Bob Propheter and McNeill Asphalt.	11		94
84837	2	1				I-80 IL Rte. 26 East 19 miles. Advanced Asphalt and Bob Propheter.	11		95
86102	3	2				IL 178 from IL Southeast of Oglesby South to Lowell	9	17	90
86139	3	2				FA 681 116 RS and 117 RS-1 Iroquois County, Resurfacing IL 116 from Ford-Iroquois County Line to 2.68 mi. east	11	13	91
86230	3	2				FA 41(14,15) RS-2 Livingston County 8.08 mi. of resurfacing and bridge deck repairs on IL 17	10	22	91
88044	4	2				US 34 Kirkwood West. S. of Gladstone to S. of Kirkwood.			88
88114	4	2			90	IL Rte. 9. SSACC Inc.			90
88155	4	2			91	IL Rte. 90. SSACC Inc. IL 91 and IL 40.	7	27	92
88180	4	2				FAI 74 Surfacers Inc.	10	12	91
90428	5	2				IL Rte. 10 from Clinton to Weldon. FAP 721	12	14	95
90527	5	2				IL Rte. 130 from Camargo to Philo. FAP 808.	9	27	95
92444	6	2				US 136 from 2 1/2 miles east of Havana and extending east 4 1/4 miles			96
94220	7	3				On Ill 130 between Mack Avenue and CXT RR in Olney,	9	12	93
94331	7	3				On Ill Rt. 161 East of Centralia to IL 37	9	16	93
96286	8	3				IL Rte. 177 from Irvington to US Rte. 151			90
96417	8	3				US Rte 51 from IL Rte 15 (at Ashley) to one mile South of the county line in Perry County	12	3	92
98126	9	3	10	11	91	Ill 146 from Hardin Co. to Golconda			
98129	9	3	10	2	92	Illinois 148 from Jeff. Co. line to N. City			
98186	9	3	2	25	94	Ill. 13/127 from Walnut to Ind. Park Dr.			
98240	9	3	7	2	93	Ill 146 from Pope Co. to Golconda			

Table B1. Second Survey (Final 52 Projects) - Strip Treatment (Continued)

Traffic									Materials				
Contract#	ADT	Ave. Hea. Daily Com. Traf.	Ave. Multi. Unit Daily Traf.	PV (Passenger Vehicles)	SU (Single Units)	Number of Lanes	Road's Class	TF (Traffic Factor)	Treatment Type A, B, or C	Quantity of Crack Control Treatment (ln ft)	Width of Strip (ft)	Brand Name For Strip Treatment (If applied)	Unit Price of Treatment $ / ln. ft.
34005	29300	1450	700	27850	750	2	2	0.179015	A	20000	1.5	Petromat	$ 0.22
80230	22100	475	100	21625	375	2	2	0.041905	A	100000	1.5	Petromat	$ 0.18
80238	22100	475	100	21625	375	2	2	0.041905	A	100000	1.5	Petromat	$ 0.25
80677	22400	1350	750	21050	600	4	1	0.20005	A	100000	1.5	Petromat	$ 0.25
82845	18900	950	200	17950	750	2	2	0.081913	A	13000	2	Nonwoven Poly	
84509	3000	200	125	2800	75	2	2	0.028502	A	20808	2	Amoco 4598	$ 0.25
84832	14200	4900	4400	9300	500	4	1	0.98585	A	61842		Poly Felt, Amo	$ 0.22
84837	17200	5700	5100	11500	600	4	1	1.143958	A	193457	2	Amoco 4598	$ 0.21
86102	3850	500	325	3350	175	2	2	0.072691	A	42508		Phillips Fiber	$ 0.22
86139	1950	150	150	1800	0	2	3	0.028961	A	28140			$ -
86230	2400	175	125	2225	50	2	2	0.027058	A	125950			$ 0.13
88044	4200	1100	1000	3100	100	2	2	0.198556	A	100633		Phillips Fiber	
88114	1550	175	90	1375	85	2	3	0.022037	A	74547	4	Phillips Fiber	$ 0.35
88155	2550	275	175	2275	100	2	2	0.0395	A	27048	4	Phillips Fiber	$ 0.35
88180	12500	3800	3100	8700	700	4	1	0.715454	A	23132	4	American Oil	$ 0.32
90428	1700	150	90	1550	60	2	3	0.020686	A	12334	2	Petromat	$ 0.26
90527	4000	100	70	3900	30	2	2	0.015464	A	211635	2	Petromat	$ 0.20
92444	2450	550	425	1900	125	2	2	0.089052	A	64865	2	Amoco	$ 0.26
94220	5300	600	400	4700	200	2 to 4	1	0.099098	A	15110	2	Amoco 4598	$ 0.59
94331	7000	425	200	6575	225	2	2	0.051644	A	7553	2	Amoco 4598	$ 0.83
96286	2200	80	30	2120	50	2	2	0.008742	A	7400	2	Amold	
96417	1800	125	50	1675	75	2	3	0.013827	A	?	2	Petromat	
98126	1950	150	50	1800	100	2	3	0.015201	A	93023	2	Petromat	$ 0.28
98129	4850	325	200	4525	125	2	2	0.045887	A	69480	2	Petromat	$ 0.21
98186	16600	450	225	16150	225	4	1	0.063362	A	13447	2	Petromat	$ 0.62
98240	1850	150	60	1700	90	2	3	0.016569	A	199917	2	Petromat	$ 0.24

Table B1. Second Survey (Final 52 Projects) - Strip Treatment (Continued)

Overlay and Fabric Thickness Positioning

Contract#	Thickness of Bituminous Overlay Lifts (in): Prior to most recent rehabilitation	Used in most recent rehabilitation: 1st Lift Binder	Used in most recent rehabilitation: 2nd Lift Binder	Used in most recent rehabilitation: Surface	Vertical Position of Crack Control Treatment: Top of Exist. Pav.	Vertical Position of Crack Control Treatment: Top of 1st Bind. Lift	Vertical Position of Crack Control Treatment: Other	Overhead Position of Crack Control Treatment: Over Center Line	Overhead Position of Crack Control Treatment: Over Wide. Joint	Overhead Position of Crack Control Treatment: Other	AC Grade Used in Overlay Mixture
34005	3" existing overlay	1.5		1.5		X			X		AC-20
80230	3" existing overlay	1.5		1.5		X			X		AC-20
80238	3" existing overlay			1.5	X				X		AC-20
80677	3" existing overlay			1.5	X				X		AC-20
82845	8" existing overlay. 1 1/2" milling of surface.			1.5	X			X	X	Long. Joints	
84509	" existing overlay.	1	1.5	1.5		X			X		AC-10
84832	" existing overlay.	1.75		1.5	X			X			AC-20
84837	" existing overlay.	1.75		1.5				X			AC-20
86102	3.625"existing overlay	1		1.5	X				X		
86139	4.25" existing overlay	1		1.5		X			X		
86230	4.5" existing overlay	0.625		1.375						1' from side	
88044	3" existing overlay.	0.75		1.25		X					AC-20
88114	2" overlay (1967). 2" overlay (1983).			1.5	X				X		AC-10
88155	4" existing overlay.	1		1.5		X			X		AC-20
88180	3" existing overlay.	1.25	1.75	1.75		X				Mid. Of lane	AC-20
90428	" existing overlay.	0.75		1.5		X			X		AC-20
90527	" existing overlay.	0.75		1.5		X		X	X		AC-20
92444	" existing overlay.	1		1.5		X			X		
94220	2" existing overlay.	0.75		1.5		X			X		AC-20
94331	5.5" and 6.25", total = 11.75"	0.75		1.5		X			X		AC-20
96286		0.75		1.5	X				X		AC-20
96417	3" existing overlay. 2" milling of surface.	0.75		1.5		X			X		AC-20
98126	" existing overlay. 3/4" milling of surface.	1		1.5				X	X		AC-20
98129	" existing overlay.	0.75		1.5	X			X	X		AC-20
98186	" existing overlay. Overlay widened to accomadate 5 lanes.	1.5		1.5					X		AC-20
98240	" existing overlay. 1/2" milling of surface.			1.5	X			X	X		AC-20

Table B1. Second Survey (Final 52 Projects) - Strip Treatment (Continued)

Pre Existing Condition																				
Contract#	Type / Condition / Preparation of Existing Pavement Prior to Treatment																			
	Type						Condition, Use CRS Abbreviations or Describe													
							AC Pavement								PCC Pavement					
				Lane Widening																
	Type of Exist. Pave.	Thick. of Exist. Pave.	Joint Spcg If PCC	Year	Width (ft)	Material	Alligator Cracking	Block Cracking	Rutting	Trans. Cra. Joint Ref. Cr	Long. Cracking	Reflective Wide. Crck	Centerline Deteriaration	Others	D-Cracking	Transverse Cracking	Long. Cracking	Faulting	Centerline Deterioration	Others
34005	PCC	9-6-9			3'BS	AC														
80230	PCC	9-6-9			3'BS	AC														
80238	PCC	9-6-9			3'BS	AC														
80677	PCC	9-6-9			3'BS	AC														
82845	PCC	9"				AC														
84509	PCC																			
84832	PCC																			
84837	PCC													X2						
86102	PCC	9-6-9			4' BS	AC														
86139	PCC	9-6-9		1971	4'BS	AC														
86230	PCC			1974	3'BS	AC														
88044	PCC				3'BS	AC		M		O	Q		S							
88114	PCC				4' BS	AC		M	N	O			S							
88155	PCC				4' BS	AC	L	M		O			S	T						
88180	CRCP	7"						M	N											
90428	PCC																			
90527	PCC								N											
92444	PCC				2' tot.	AC														
94220	PCC																			
94331	PCC	9-6-9			3' B S	AC														
96286	JRCP				3' B S	AC														
96417	PCC				4' B S	AC			N											
98126	PCC																			
98129	PCC																			
98186	PCC																			
98240	PCC																			

Table B1. Second Survey (Final 52 Projects) - Strip Treatment (Continued)

Maintenance & Rehabilitation Reported in Surveys																			
	Prior to Treatment Preparation				Crack Sealing Since Overlay						Subsequent AC Overlay				Other Maintenance or Rehabilitation				
					1st			2nd											
Contract#	Crack Sealing	Rotomilling	Full / Partial PCC /AC patch	Other	Year	Ln. Ft.	$ / ft.	Year	Ln. Ft.	$ / ft.	Thickness	Year	Quantity (Tons)	$ / Ton	Type	Year	Quantity	Quantity Unit (e.g. ft)	Unit Price
34005															Minor liquid sealing				
80230																			
80238																			
80677																			
82845		X																	
84509																			
84832		X																	
84837																			
86102																			
86139																			
86230																			
88044					1991														
88114																			
88155																			
88180																			
90428			FP & FA	Cln. & Fill															
90527	X				96	58,092	0.47	Same	36,200	0.64									
92444		X	F																
94220	X		A																
94331																			
96286			F																
96417	X	X																	
98126		X																	
98129																			
98186																			
98240		X																	

Table B2. Second Survey (Final 52 Projects) - Area Treatment

Contract#	District	Zone	Date Let			Job Description: Brief Job Description	Date Completed		
			Month	Date	Year		Month	Date	Year
40229	4	2			85	FA 53. U.S. 136. McDonough			86
84995	2	1				IL Rte. 251 North of U.S. 30.	11		95
86139	3	2				FA 681 116 RS and 117 RS-1 Iroquois County, Resurfacing IL 116 from 2.68 mi. east of Ford-Iroquois County Line to Ashkum	11	13	91
88019	4	2				FA 685 IL 9. E. of IL 41 Junction.			88
88205	4	2			92	IL Rte. 94 and 17. Surfacers Inc.			92
88621	4	2			94	U.S. Rte. 150. IL 74 to Jubilee Park.	10	19	95
92766	6	2				US 66 from IL 10 in Lincoln to Salt Creek S. of Lincoln			94
93061	6	2				Chestnut street from 8 th to 12 th streets in Quincy	1	26	93
93168	6	2				FAS Route 461 from Manito Southwesterly to 1 mile N.E. of Forest City	8	7	95
95135	7	3				On FAS 806 Bridgeport Road.	9	19	94
95153	7	3				On FAS 819 Texico to CH2.	10	24	94
96539	8	3				IL 111 from Pontoon Rd. to Chain of Rocks Rd. in Pontoon Beach.			94
98126	9	3	10	11	91	Ill.146 Widen & Resurface			
98193	9	3	10	14	94	Illinois 13 from Fair St. to Old Rt. 13			
98201	9	3	7	10	92	Illinois 13 in Marion & Various			
98210	9	3	1	14	94	Ill 151 from Ill.3 to Ill.4 in Ava			
98278	9	3	10	6	95	U.S. 51 Middle Relocation in Union Co.			96

Table B2. Second Survey (Final 52 Projects) - Area Treatment (Continued)

	Traffic								Materials			
Contract#	ADT	Ave. Hea. Daily Com. Traf.	Ave. Multi. Uni. Daily Traf.	PV	SU	Number of Lanes	Road's Class	TF (Traffic Factor)	Treatment Type A, B, or C	Quantity of Crack Control Treatment (sq. yd.)	Brand Name For Strip Treatment (If applied)	Unit Price of Treatment $ / sq. yd.
40229	4450	450	375	4000	75	2	2	0.076772	A	25820	Phillips Fiber	
84995	1900	150	100	1750	50	2	3	0.022077	A	67269	AmoPave	$ 0.75
86139	1950	150	150	1800	0	2	3	0.028961	A	84267	Spartan Technology	$ 0.76
88019	875	125	60	750	65	2	3	0.015134	A	14280	Phillips Fiber	
88205	4900	250	125	4650	125	2	2	0.031443	A	62069	American Oil	$ 1.00
88621	3400	250	30	3150	220	2	2	0.018344	A	153921	AmoPave 4598	$ 0.70
92766	5700	180	95	5520	85	4	1	0.026069	A	12771	Amoco 4599 & 4598	$ 1.12
93061	4700	160	100	4540	60	2 driv.+2 park.	2	0.022974	A	7851	Amoco	$ 1.63
93168	5200	260	260	4940	0	2	2	0.050478	A	31365	Amoco 4598	$ 1.85
95135	900	75	10	825	65	2	3	0.005531	A	73333	Polyfelt PGM 15	$ 0.61
95153	850	100	10	750	90	2	3	0.006889	A	45402	Amoco Pave	$ 0.80
96539	15100	900	350	14200	550	4	1	0.109751	A	2400		
98126	1950	150	50	1800	100	2	3	0.015201	A	29340	Petromat	
98193	12500	1000	750	11500	250	4	1	0.178536	A	21098	Petromat	$ 1.22
98201	30600	1450	850	29150	600	4	1	0.22231	A	18458	Petromat	$ 1.00
98210	1100	80	40	1020	40	2	3	0.009946	A	9629	Petromat	$ 1.18
98278	4750	300	150	4450	150	2	2	0.037646	A	12234	Petromat	$ 0.68

Table B2. Second Survey (Final 52 Projects) - Area Treatment (Continued)

Overlay and Fabric Thickness Positioning								
Contract#	Thickness of Bituminous Overlay Lifts (in)				Position of Crack Control Treatment			AC Grade Used in Overlay Mixture
	Prior to most recent rehabilitation	Used in most recent rehabilitation						
		1st Lift Binder	2nd Lift Binder	Surface	Top of Exist. Pav.	Top of 1st Bind. Lift.	Other	
40229	3" existing overlay.	2	0.75	1.25		X		AC 70-85
84995	4" existing overlay.			3	X			AC-10
86139	5.375" existing overlay	1		1.5		X		
88019	3" existing overlay.	0.75		1.25	X			AC-10
88205	3" existing overlay.			2				AC-20
88621	6" existing overlay.			1.5				AC-10
92766	"existing overlay	0.75		1.5	X			
93061	"existing overlay	1.5		1.5	X			
93168	"existing overlay	1.5		1.5	X			
95135	4" existing overlay	0.75	1.5	1.5				
95153	Existing 1" surface over 1 1/2" binder over 7" soil cement base.	0.75		2.5		X		AC-10
96539								
98126	" existing overlay.	2	2	1.5		X		AC-20
98193	" existing overlay.	2.75		1.5	X			AC-20
98201				1.5	X			AC-20
98210	" existing overlay.	0.75		1.5		X		AC-20
98278	" existing overlay.	1.5		1.5				AC-20

Table B2. Second Survey (Final 52 Projects) - Area Treatment (Continued)

Pre Existing Condition																				
Contract#	Type / Condition / Preparation of Existing Pavement Prior to Treatment																			
	Type						Condition, Use CRS Abbreviations or Describe													
				Lane Widening			AC Pavement								PCC Pavement					
	Type of Exist. Pave.	Thick. of Exist. Pave.	Joint Spcg if PCC	Year	Width (ft)	Material	Alligator Cracking	Block Cracking	Rutting	Trans. Cra. Joint Ref. Cr	Long. Cracking	Reflective Wide. Crck	Centerline Deteriaration	Others	D-Cracking	Transverse Cracking	Long. Cracking	Faulting	Centerline Deterioration	Others
40229	PCC	9-6-9			3' BS	AC				O		R	S	T_						
84995	PCC																			
86139	PCC	9-6-9		1960 and 197	4'BS	AC														
88019	PCC	9-6-9						M		O			S							
88205	PCC				2' BS	AC			N	O		R	S							
88621	PCC				4' BS	AC		M			Q	R	S							
92766	PCC													Medium Cracking						
93061	PCC																			
93168	AC													Some Cracking						
95135	AC	4"			2.5 B S	AC														
95153	Soil Ce	7"					L2													
96539	PCC	10-8-10																		
98126	PCC																			
98193	PCC																			
98201																				
98210	PCC																			
98278	PCC																			

Table B2. Second Survey (Final 52 Projects) - Area Treatment (Continued)

Maintenance & Rehabilitation Reported in Surveys																						
Contract#	Prior to Treatment Preparation				Crack Sealing Since Overlay						Subsequent AC Overlay				Other Meintenance or Rehabilitation				
					1st			2nd											
	Crack Sealing	Rotomilling	Full / Par. PCC / AC Patch	Miscellaneous	Year	Ln. Ft.	$ / ft.	Year	Ln. Ft.	$ / ft.	Thickness	Year	Quantity (Tons)	$ / Ton	Type	Year	Quantity	Quantity Unit (e.g. ft)	Unit Price
40229																			
84995		X																	
86139																			
88019											1.5	1993							
88205	X				1995	94425	0.38												
88621																			
92766		X																	
93061																			
93168																			
95135			FA																
95153																			
96539																			
98126																			
98193			PA																
98201																			
98210																			
98278																			

Table B3. Second Surveys (Final 52 Projects) - Control Sections

Job Descriptions									
Contract#	District	Zone	Date Let			Brief Job Description	Date Completed		
			Month	Date	Year		Month	Date	Year
40229	4	2				FA 53. U.S. 136. McDonough			86
84995	2	1				IL 251 South of US 30.	10		95
86102	3	2				IL 178 from IL Southeast of Oglesby South to Lowell	9	17	90
88019	4	2				FA 685 IL 9 McDonough			93
88044	4	2				US 34 South of Kirkwood to South of Gladstone			88
90527	5	2				IL Rte. 130 from Camargo to Philo. The south portion of this contract, from Villa Grove to Camargo was not treated.	9	27	95
92766	6	2				Resurfacing on old US 66 from IL 10 in Lincoln to Salt Creek S. of Lincoln. From station 4+50 North to 72+00 Southerly only the turn lanes were done. From 72+00 to 85+00 the driving lanes were done.	8	24	95
96384	8	3				IL Rte. 4/13 from Marissa to Tilden			93
96539	8	3				IL 111 from Pontoon Rd. to Chain of Rocks Rd. in Pontoon Beach.			94

Table B3. Second Surveys (Final 52 Projects) - Control Sections (Continued)

Traffic								
Contract#	ADT	Ave. Hea. Daily Com. Traf.	Ave. Multi. Uni. Daily Traf.	PV	SU	Number of Lanes	Road's Class	TF (Traffic Factor)
40229	4450	450	375	4000	75	2	2	0.076772
84995	1200	80	60	1120	20	2	3	0.012706
86102	3850	500	325	3350	175	2	2	0.072691
88019	875	125	60	750	65	2	3	0.015134
88044	4200	1100	1000	3100	100	2	2	0.198556
90527	4000	100	70	3900	30	2	2	0.015464
92766	5700	180	95	5520	85	4	1	0.026069
96384	6300	275	150	6025	125	2	2	0.036364
96539	15100	900	350	14200	550	4	1	0.109751

Table B3. Second Surveys (Final 52 Projects) - Control Sections (Continued)

Overlay and Existing Pavement											
Contract#	Thickness of Bituminous Overlay Lifts (in)				AC Grade Used in Overlay Mixture	Existing Pavement Prior to Treatment					
						Type					
	Prior to most recent rehabilitation	Used in most recent rehabilitation							Lane Widening		
		1st Lift Binder	2nd Lift Binder	Surface		Type of Exist. Pave.	Thick. of Exist. Pave.	Joint Spcg if PCC	Year	Width (ft)	Material
40229	3" existing overlay.	2	0.75	1.25	AC-70	PCC	9-6-9			3' BS	AC
84995	4 " existing overlay.			1.5	AC-10	PCC					
86102	3.625" existing overlay.	1		1.5		PCC	9-6-9			4' BS	AC
88019	3" existing overlay.	0.75		1.25	AC-10	PCC	9-6-9				
88044	3" existing overlay.	0.75		1.25	AC-20	PCC				3'BS	AC
90527	" existing overlay.	0.75		1.5	AC-20	PCC					
92766	" existing overlay	0.75		1.5		PCC					
96384	" existing overlay.	0.75		1.5		PCC				2 BS	AC
96539						PCC	10-8-10				

Table B3. Second Surveys (Final 52 Projects) - Control Sections (Continued)

Pre Existing Condition														
	Type / Condition / Preparation of Existing Pavement Prior to Treatment													
	Condition, Use CRS Abbreviations or Describe													
	AC Pavement								PCC Pavement					
Contract#	Alligator Cracking	Block Cracking	Rutting	Trans. Cra. Joint Ref. Cr	Long. Cracking	Reflective Wide. Crck	Centerline Deteriaration	Others	D-Cracking	Transverse Cracking	Long. Cracking	Faulting	Centerline Deterioration	Others
40229														
84995														
86102														
88019		M		O			S							
88044		M		O	Q		S							
90527														
92766														
96384														
96539														

Table B3. Second Surveys (Final 52 Projects) - Control Sections (Continued)

Maintenance & Rehabilitation Reported in Surveys																				
Contract#	Preparation				Crack Sealing Since Overlay 1st			Crack Sealing Since Overlay 2nd			Subsequent AC Overlay				Other Meintenance or Rehabilitation					
	Type of Exist. Pave.	Rotomilling	Full / Par. PCC patch	Miscellaneous	Year	Ln. Ft.	$ / ft.	Year	Ln. Ft.	$ / ft.	Thickness	Year	Quantity (Tons)	$ / Ton	Type	Year	Quantity	Quantity Unit (e.g. ft)	Unit Price
40229		X			89														
84995			FA																
86102																			
88019																			
88044					90			91											
90527																			
92766																			
96384		X	F																
96539																			

Appendix C

(Second Surveys - All Data)

Table C1. Second Surveys (All Data) - Strip Treatment

Contract#	District	Zone	Date Let Month	Date Let Date	Date Let Year	Job Description: Brief Job Description	Date Completed Month	Date Completed Date	Date Completed Year
34005	1	1				Route 12 (Old Rand Rd.) Wauconda			80
38823	4	2			85	IL 88 (IL 40) Peoria. Crack control on 5 lane sections Pioneer Parkway to IL 6. South of Forrest Lawn Road to Timberlane (Peoria).			85
42312	8	3				IL 111 from Rosemont to Hill Avenue in Washington Park			90
60016	1	1				Thatcher Ave. fom North Ave. to 1st Ave. in River Grove, IL.	11	16	96
64126	2	1				IL Rte. 70 South of Durand. Rockford Blacktop Construction.	9	18	96
80230	1	1				Route 176 Wauconda to Mundelein			88
80238	1	1				Route 176 Wauconda to Mundelin			89
80635	1	1					10	31	96
80677	1	1				Route 12 from Volo to Fox Lake			91
80903	1	1					8	27	93
82471	1	1				IL Rte. 120 at Mill Rd. on both sides.	5	15	97
82845	1	1				U.S. Rte. 45 from Winchester Rd. to IL Rte 120. Over existing widening on both sides.	11		95
82855	1	1				IL Rte. 59 from 111st to 127th.	8	13	96
82913	1	1					7		97
84469	2	1				IL Rte. 76, Belvidere to Wisconsin. North half of job surfaced in 1994. South surfaced in 1995.	7		96
84484	2	1				IL Rte. 92 in E. Moline. Brandt Construction Company.	7		96
84509	2	1				IL Rte. 26, Princeton to Bureau Juntion. Advanced Asphalt Co.	11		95
84579	2	1				U.S. Business 20 at Mulford. Rockford Blacktop Construction.	6		96
84681	2	1				Ogdan Avenue in Geneseo. Valley Construction Co.	11		96
84698	2	1				U.S. Rte. 6 and 34 from Sheffield to IL Rte. 40. McNeil Asphalt Co.	8		96
84699	2	1				U.S. Rte. 20 from Galena to Mt. Hope Rd. Civil Constructors, Inc.	10		96
84785	2	1				U.S. Rte. 150 North of IL Rte. 81. Valley Construction.	11		96
84832	2	1				I-80 Princeton W - 10 mi. Bob Propheter and McNeill Asphalt.	11		94
84837	2	1				I-80 IL Rte. 26 East 19 miles. Advanced Asphalt and Bob Propheter.	11		95
84997	2	1				IL Rte. 23 in DeKalb. Alliance Contractors.	6		96
86102	3	2				IL 178 from IL Southeast of Oglesby South to Lowell	9	17	90
86102	3	2				IL 178 from IL Southeast of Oglesby South to Lowell	9	17	90
86139	3	2				FA 681 116 RS and 117 RS-1 Iroquois County, Resurfacing IL 116 from Ford-Iroquois County Line to 2.68 mi. east	11	13	91
86199	3	2				FA 619 103 W & RS LaSalle County Bituminous base course widening and resurfacing on IL 71 near Cedar Point.	12	13	91
86202	3	2				FA 635 (105, 106) RS-1 Lasalle County 10.9 mi. bituminous concrete resurfacing on IL 18 South of Lostant	7	19	91
86206	3	2				FA 68 (103, 104, 105) RS-2 Livingston County 8.63 mi. of resurfacing on IL 23 from Cornell to pontiac	10	10	91
86230	3	2				FA 41(14,15) RS-2 Livingston County 8.08 mi. of resurfacing and bridge deck repairs on IL 17	10	22	91
86278	3	2				FA 693 (120, 128, 129) RS McLean County Cold milling and resurfacing on IL 9 - IL 122 to IL 150 West of Bloomington	11	5	91
86317	3	2				FA 46 (70, 67, 68) RS-4 LaSalle County Cold mill and bit. concretesurfacing on US 51 south of IL 18 to south of IL71.	8	16	93
88044	4	2				US 34 Kirkwood West. S. of Gladstone to S. of Kirkwood.			88
88087	4	2				Jackson St. in Morton. RAC 475-16.	5	13	92
88089	4	2			93	IL Rte. 91 form Princeville West to IL Rte. 78. Laura to Princeville			
88114	4	2			90	IL Rte. 9. SSACC Inc.			90
88151	4	2			92	IL Rte. 29. SSACC Inc. Henry Sooth	10	29	93
88152	4	2			91	IL Rte. 29 from Chillincothe North to Sparland. SSACC Inc.	11	24	92

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Contract#	District	Zone	Date Let Month	Date Let Date	Date Let Year	Job Description: Brief Job Description	Date Completed Month	Date Completed Date	Date Completed Year
88155	4	2			91	IL Rte. 90. SSACC Inc. IL 91 and IL 40.	7	27	92
88180	4	2				FAI 74 Surfacers Inc.	10	12	91
88183	4	2			90	IL Rte. 41 and 9. SSACC Inc.	5	28	91
88195	4	2			92	SBI 83 and SBI 180. Galva to E. of Victoria.			93
88205	4	2			92	IL Rte. 94 and 17. Surfacers Inc.	5	5	93
88432	4	2				IL Rte. 98. SSACC Inc.	7	29	93
90274	5	2				U.S. Rte. 45 from Savoy to Tolono			97
90389	5	2				Hungry Hollow Rd. West of Danville.			97
90405	5	2				Leverett Rd. from Market St. to U.S. Rte. 45.	10		96
90420	5	2				IL Rte. 32 from Lovington to North of Laplace.	9	12	96
90428	5	2				IL Rte. 10 from Clinton to Weldon. FAP 721	12	14	95
90441	5	2				Montrose Rd. from IL Rte. 121 South to Cumperland/Effingham county line. FAP 828.	10	26	95
90527	5	2				IL Rte. 130 from Camargo to Philo. FAP 808.	9	27	95
90562	5	2				IL Rte. 16 from Windsor to 33rd St. in Mattoon. FAP 325.	11	9	94
90595	5	2				IL Rte. 130 from Greenup to Jasper County Line. FAP 116.	3	14	96
92274	6	2				Resurfacing on IL 96 from the Adams -Hancock County Line Northerly 10.8 miles	6	28	96
92295	6	2				Resurfacing on IL 100 from IL 106 in Detroit to 3/4 mile south of Milton	11	23	94
92378	6	2				Resurfacing on IL 106 from 1.25 miles N. of Asley Southerly to the Scott-Greene County Line	12	2	94
92382	6	2				Resurfacing on IL 123 from 1 mile east of Petersburg to IL 29	3	30	96
92432	6	2				Resurfacing on IL 185 from 3 mile east of Coffeen to the Fayette County Line	5	29	95
92440	6	2				Resurfacing on US 24 from TR600N Northerly to Rushville	6	28	93
92444	6	2				US 136 from 2 1/2 miles east of Havana and extending east 4 1/4 miles			96
92458	6	2				Resurfacing on IL 123 from 97/123 Junction to IL 125 West of Pleasant Plains	6	28	96
92476	6	2				Resurfacing on IL 78 from the east branch of the Illinois River in Bath to Saidora Road	11	27	95
92757	6	2				Resurfacing on IL 104 from the west limits of Bulpitt to IL 29 at Taylorville	11	21	94
92816	6	2				Resurfacing on IL 121 from Mt. Pulaski to the Macon County Line	11	23	94
94173	7	3				On Ill 15 at west edge of Wayne City,	4	25	94
94220	7	3				On Ill 130 between Mack Avenue and CXT RR in Olney,	9	12	93
94255	7	3				On Ill 33 North of Willow Hill,	6	30	94
94270	7	3				On FAI 57 and 64 at North Tri-level @ Mt. Vernon,	7	20	94
94331	7	3				On Ill Rt. 161 East of Centralia to IL 37	9	16	93
94359	7	3				On Ill Rt. 142 from Mc Leansboro to Ham-Saline Co. Line,	6	12	95
94435	7	3				On US 45 from Jeffersonville (Geff) to US Rt.50,	8	19	94
94554	7	3				On US 45 from Flora to US Rt.50,	7	15	96
96017	8	3				IL 140 from IL 160 E. for 11 miles.	11		89
96155	8	3				IL 158 Millstadt to Douglas Road	3		91
96198	8	3				FA 600 (IL Rte. 159) from IL Rte. 161 in Belleville to South of Lincoln Highway in Fairview Heights	10	14	90
96229	8	3				IL Rte. 106 from IL Rte. 267 in Whitehall to the Scott Co. Line	7	20	90
96238	8	3				IL 163 Millstadt to Centreville	8		90
96239	8	3				IL 156 Waterloo to Hecker	6		90
96272	8	3				IL 156 Valmeyer to Waterloo	8		91

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Contract#	District	Zone	Date Let			Job Description: Brief Job Description	Date Completed		
			Month	Date	Year		Month	Date	Year
96273	8	3				IL 158 Millstadt to Belleville	8		91
96286	8	3				IL Rte. 177 from Irvington to US Rte. 151			90
96288	8	3				Resurface Old Rte. 50 from the St. Clair County line to Trenton in Clinton County	11	2	90
96314	8	3				IL 159 from North of I55/70 to IL Route 162 in Maryville widening and resurfacing for 3 rd lane			91
96384	8	3				IL Rte. 4/13 from Marissa to Tilden	3		94
96403	8	3				IL Rte. 4/150 from Steeleville to Percy	2		93
96417	8	3				US Rte 51 from IL Rte 15 (at Ashley) to one mile South of the county line in Perry County	12	3	92
96514	8	3				IL Rte. 203 from big Bend to Alexander Streets in Madison & Granite City	8	16	94
96539	8	3				IL 111 from Pontoon Rd. to Chain of Rocks Rd. in Pontoon Beach.			94
96555	8	3				IL 127 from US 40 to US 50	10		93
96660	8	3				IL Rte. 150 from Chester to Route 4	9		94
96821	8	3				IL 4 from I-70 to US 50	10		94
98126	9	3	10	11	91	Ill 146 from Hardin Co. to Golconda			
98129	9	3	10	2	92	Illinois 148 from Jeff. Co. line to N. City			
98186	9	3	2	25	94	Ill. 13/127 from Walnut to Ind. Park Dr.			
98187	9	3	2	24	95	Ill. 13/127 from Ind. Park Drive northerl.			
98199	9	3	5	20	94	RS three locations in District 9			
98210	9	3	1	14	94	Ill 151 from Ill. 3 to Ill.4			
98225	9	3	5	20	94	Ill. 34 from Benton to Galatia			
98227	9	3	5	20	94	6 Locations on Ill. 14, Ill. 13 & US 51...IL Rte 14			
98230	9	3	7	1	94	FD on Ill. 13 from Ill. 166 to Co. line			
98240	9	3	7	2	93	Ill 146 from Pope Co. to Golconda			
98255	9	3	2	25	94	RS at 8 Locations in D-9			
98268	9	3	11	22	96	Illinois 1 from Illinois 13 to Omaha			
98269	9	3	6	10	94	RS Locations on Ill127			
98274	9	3	5	20	94	Ill 149 in W. F.			
98288	9	3	5	20	94	US 45 in Metropolis			
98333	9	3	8	26	94	IL 154			
98338	9	3	7	7	95	Ill 142 from Ill 13 to Eldorado			
98339	9	3	7	7	95	IL 148			
98355	9	3	5	19	95	Illinois 169 near Karnak			
98388	9	3	8	30	96	Herrin Street west of Herrin			
98400	9	3	8	30	96	Illinois 148 South of Herrin			
98402	9	3	8	30	96	IL 13.			
X1	8	3				IL 159 in Collinsville from Angle St. N. to Illinois St.	5		89
X2	8	3				IL 4 from I-64 N. to Lebanon (RR crossing at S. end of town.)	6		90
X3	8	3				IL 160 from Highland to Trenton.			90
X4	8	3				IL 157, 3/4 miles N. of FAI 55/70 section 1.4 mi. in length.			91

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Traffic									Materials				
Contract#	ADT	Ave. Hea. Daily Com. Traf.	Ave. Mult. Unit Daily Traf.	PV (Passenger Vehicles)	SU (Single Units)	Number of Lanes	Road's Class	TF (Traffic Factor)	Treatment Type A, B, or C	Quantity of Crack Control Treatment (ln ft)	Width of Strip (ft)	Brand Name For Strip Treatment (If applied)	Unit Price of Treatment $ / ln. ft.
34005	29300	1450	700	27850	750	2	2	0.17902	A	20000	1.5	Petromat	$ 0.22
38823	29300	950	150	28350	800	5	1	0.08218	C	7370	4	Phillips Fiber	
42312	13200	400	100	12800	300	Notes*		0.00638	A	10700	2		
60016	15100	0	0	15100	0	2	2	0.00113	A	7000	1	Petromat	$ 0.23
64126	2050	100	30	1950	70	2	2	0.00985	A	10901	2	Amoco	$ 0.30
80230	22100	475	100	21625	375	2	2	0.04191	A	100000	1.5	Petromat	$ 0.18
80238	22100	475	100	21625	375	2	2	0.04191	A	100000	1.5	Petromat	$ 0.25
80635	37300	1400	600	35900	800				B	35389			
80677	22400	1350	750	21050	600	4	1	0.20005	A	100000	1.5	Petromat	$ 0.25
80903	51300	1600	550	49700	1050				B	7775			
82471	24200	1400	650	22800	750	2	2	0.169	A	11703	2	Nonwoven Polypropylene	
82845	18900	950	200	17950	750	2	2	0.08191	A	13000	2	Nonwoven Polypropylene	
82855	13600	2400	1450	11200	950	2	2	0.33351	A	33120	2	Producer Synthetic	$ 0.16
82913	17600	1000	450	16600	550				A				
84469	6900	250	125	6650	125	2	2	0.03159	A	97513	2	Exxon	$ 0.40
84484	16600	2150	1800	14450	350				A	10250	2	Amoco 4598	$ 0.53
84509	3000	200	125	2800	75	2	2	0.0285	A	20808	2	Amoco 4598	$ 0.25
84579	36700	250	100	36450	150	Notes			A	10924	2	Amoco 4598	$ 0.51
84681	5000	275	150	4725	125	2	2	0.03627	A	11232	2	Amoco 4598	$ 0.38
84698	2200	275	175	1925	100	2	2	0.03947	A	30381	2	Amoco 4598	$ 0.25
84699	7100	550	350	6550	200	2	2	0.07915	A	12416	2	Road Fabrics	$ 0.85
84785	3100	350	225	2750	125	2	2	0.05057	A	8358	2	Amoco 4598	$ 0.87
84832	14200	4900	4400	9300	500	4	1	0.98585	A	61842		Poly Felt, Amo Pave, Road Fabrics American Oil Co.	$ 0.22
84837	17200	5700	5100	11500	600	4	1	1.14396	A	193457	2	Amoco 4598	$ 0.21
84997	15400	600	225	14800	375	5	1	0.07221	A	17231		Notes	$ 0.45
86102	3850	500	325	3350	175	2	2	0.07269	A	42508		Phillips Fiber	$ 0.22
86102	3850	500	325	3350	175	2	2	0.07269	A	42508		Phillips Fiber	$ 0.22
86139	1950	150	150	1800	0	2	3	0.02896	A	28140			$ -
86199	2750	325	225	2425	100	2	2	0.04915	A	94231		Phillips Fiber Corp	$ 0.30
86202	2950	250	200	2700	50	2	2	0.04155	C	57552			$ 1.45
86206	3100	200	125	2900	75	2	2	0.02851	C	75135			$ 1.45
86230	2400	175	125	2225	50	2	2	0.02706	A	125950			$ 0.13
86278	5500	325	175	5175	150	2	2	0.04252	C	61400			
86317	14900	3000	2700	11900	300	2	2	0.53805	C	105074			$ 1.60
88044	4200	1100	1000	3100	100	2	2	0.19856	A	100633		Phillips Fiber	
88087	12100	450	150	11650	300	5	1	0.05124	A	24406	4	Phillips Fiber	$ 0.35
88089	1550	200	125	1350	75	2	3	0.02822	A	113449	4	American Oil	
88114	1550	175	90	1375	85	2	3	0.02204	A	74547	4	Phillips Fiber	$ 0.35
88151	3750	550	350	3200	200	2	2	0.0789	A	58067.5	4	American Oil	$ 0.32
88152	7100	550	350	6550	200	2	2	0.07915	A	84201	4	Phillips Fiber	$ 0.36

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Traffic									Materials				
Contract#	ADT	Ave. Hea. Daily Com. Traf.	Ave. Multi. Unit Daily Traf.	PV (Passenger Vehicles)	SU (Single Units)	Number of Lanes	Road's Class	TF (Traffic Factor)	Treatment Type A, B, or C	Quantity of Crack Control Treatment (In ft)	Width of Strip (ft)	Brand Name For Strip Treatment (If applied)	Unit Price of Treatment $ / In. ft.
88155	2550	275	175	2275	100	2	2	0.0395	A	27048	4	Phillips Fiber	$ 0.35
88180	12500	3800	3100	8700	700	4	1	0.71545	A	23132	4	American Oil	$ 0.32
88183	3000	300	200	2700	100	2	2	0.04435	A	40416	4	Phillips Fiber	$ 0.26
88195	1000	69	29	931	40	2	3	0.00783	A	37368	4		$ 0.40
88205	4900	250	125	4650	125	2	2	0.03144	A	8516	4	American Oil	$ 0.60
88432	6000	850	400	5150	450	2	2	0.10269	A	11796		American Oil	$ 0.45
90274	8000	375	200	7625	175	4	1	0.05438	A	64967	2	Petromat	$ 0.35
90389	1900	23	6	1877	17	2	3	0.00222	A	8328	2	Petromat	$ 0.25
90405	1700	33	25	1667	8	2	3	0.00537	A	7971	2	Petromat	$ 0.30
90420	2050	275	150	1775	125	2	2	0.03604	A	31200	2	Midwest Const.	$ 0.31
90428	1700	150	90	1550	60	2	3	0.02069	A	12334	2	Petromat	$ 0.26
90441	2000	100	77	1900	23	2	3	0.0162	A	37006	2	Petromat	$ 0.25
90527	4000	100	70	3900	30	2	2	0.01546	A	211635	2	Petromat	$ 0.20
90562	4600	225	125	4375	100	2	2	0.03002	A	14121	2		$ 0.33
90595	2400	250	200	2150	50	2	2	0.04151	A	12000	2		$ 0.32
92274	2300	275	150	2025	125	2	2	0.03606	A	168499	2	Amoco 4598	$ 0.28
92295	1150	80	40	1070	40	2	3	0.00995	C	51312	2	Amoco 4599	$ 0.30
92378	1900	80	60	1820	20	2	3	0.01276	A	47812	2	Amoco 4598	$ 0.26
92382	1900	275	100	1625	175	2	3	0.02889	A	66983	2	Amoco 4598	$ 0.35
92432	1600	225	125	1375	100	2	3	0.02958	A	49420	2	Amoco 4598	$ 0.29
92440	2850	375	250	2475	125	2	2	0.05537	A	62619	2	Geosynthetics	$ 0.40
92444	2450	550	425	1900	125	2	2	0.08905	A	64865	2	Amoco	$ 0.26
92458	1200	80	60	1120	20	2	3	0.01271	A	97466	2	Amoco 4598	$ 0.24
92476	1550	125	70	1425	55	2	3	0.01656	A	61144	2	Amoco 4599	$ 0.24
92757	5200	250	150	4950	100	2	2	0.03488	A	68928	2	Amoco 4599	$ 0.32
92816	4350	550	375	3800	175	2	2	0.08236	A	59636	2	Amoco 4599&4598	$ 0.28
94173	5000	200	80	4800	120	2	2	0.0225	A	13450	2	Petromat	$ 0.70
94220	5300	600	400	4700	200	2 to 4	1	0.0991	A	15110	2	Amoco 4598	$ 0.59
94255	3400	450	300	2950	150	2	2	0.06644	A	38614	2	Polyfelt TS PGM 14	$ 0.34
94270	33900	7800	6900	26100	900	2 to 4	1	1.55368	A	19681	2	AmoPave	$ 0.37
94331	7000	425	200	6575	225	2	2	0.05164	A	7553	2	Amoco 4598	$ 0.83
94359	4200	100	100	4100	0	2	2	0.01958	A	102322	2	AmoPave	$ 0.25
94435	3150	250	250	2900	0	2	2	0.0484	A	46190	2	AmoPave	$ 0.31
94554	5500	475	475	5025	0	2	2	0.09192	A	15077	2	AmoPave	$ 0.69
96017	1700	150	70	1550	80	2	3	0.01793	A		2		
96155	5200	275	100	4925	175	2	2	0.02945	A	31680	2	Petromat	
96198	31500	1600	1500	29900	100	5	1	0.33369	A	40000	2	Petromat	
96229	1500	80	60	1420	20	2	3	0.01273	A	58924	2	Philips Fiber Corp	
96238	3500	375	175	3125	200	2	2	0.04517	A	69000	2	Petromat	
96239	3000	80	40	2920	40	2	2	0.01017	A	93000	2	Petromat	
96272	1000	125	50	875	75	2	3	0.01377	A	101900	2	Petromat	

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Traffic									Materials				
Contract#	ADT	Ave. Hea. Daily Com. Traf.	Ave. Multi. Unit Daily Traf.	PV (Passenger Vehicles)	SU (Single Units)	Number of Lanes	Road's Class	TF (Traffic Factor)	Treatment Type A, B, or C	Quantity of Crack Control Treatment (ln ft)	Width of Strip (ft)	Brand Name For Strip Treatment (If applied)	Unit Price of Treatment $ / ln. ft.
96273	6600	600	400	6000	200	2	2	0.08874	A	50787	2	Petromat	
96286	2200	80	30	2120	50	2	2	0.00874	A	7400	2	Amold	
96288	6400	600	325	5800	275	2	2	0.07848	A	23200	2	Petromat	
96314	19100	375	60	18725	315	3	1	0.03307	A	11371	2	Philips Fiber Corp	
96384	6300	275	150	6025	125	2	2	0.03636	o treatmen	60000	None	None	None
96403	6200	375	225	5825	150	2	2	0.0522	A	43500	2	AmoPave	$ 0.32
96417	1800	125	50	1675	75	2	3	0.01383	A	?	2	Petromat	
96514	18000	800	175	17200	625	4	1	0.07643	A	18491	2	Phillips Fiber Corp.	$ 0.42
96539	15100	900	350	14200	550	4	1	0.10975	A	2679			
96555	4500	350	225	4150	125	2	2	0.05068	A	260389	2	Amoco	
96660	5500	425	325	5075	100	2	2	0.06862	A	84702	2	AmoPave	$ 0.35
96821	6100	600	500	5500	100	2	2	0.10238	A	97838	2	Amoco	
98126	1950	150	50	1800	100	2	3	0.0152	A	93023	2	Petromat	$ 0.28
98129	4850	325	200	4525	125	2	2	0.04589	A	69480	2	Petromat	$ 0.21
98186	16600	450	225	16150	225	4	1	0.06336	A	13447	2	Petromat	$ 0.62
98187	9500	350	150	9150	200	2 & 4	1	0.04511	A	12449	2	Petromat	$ 0.49
98199						2			A	22125	2	Petrofit	$ 0.40
98210	1100	80	40	1020	40	2	3	0.00995	A	74978	2	Petromat	$ 0.28
98225	3100	275	125	2825	150	2	2	0.03271	A	254168	2	Petromat	$ 0.21
98227	3650	225	225	3425	0	2	2	0.04362	A	28765	2	Petromat	$ 0.38
98230	7500	550	350	6950	200	4	1	0.08839	A	34000	2	Petromat	$ 0.29
98240	1850	150	60	1700	90	2	3	0.01657	A	199917	2	Petromat	$ 0.24
98255						2			A	39666	2	Petromat	$ 0.55
98268	2450	250	150	2200	100	2	2	0.03468	A	56970	2	Petromat	$ 0.73
98269	1950		90			2	3	0.0173	A	18600	2	Petromat	$ 0.33
98274	8800	450	225	8350	225	2	2	0.0566	A	85588	2	Petromat	$ 0.30
98288	9700	325	90	9375	235	2	2	0.03121	A	34751	2	Petromat	$ 0.32
98333	3750		175			2	2	0.03373	A	15834	2	Petromat	
98338	2100	400	225	1700	175	2	2	0.05329	A	97717	2	Petromat	$ 0.20
98339	4700		60			2	2	0.01156	A	111028	2	Petromat	$ 0.18
98355	2150	150	60	2000	90	2	2	0.01676	A	11000	2	Petromat	$ 0.50
98388	7150	150	100	7000	50	2	2	0.0226	A	28072	2	Petromat	$ 0.24
98400	17000	375	150	16625	225	2	2	0.04276	A	13696	2	Petromat	$ 0.89
98402	15300		425			2 & 4	1	0.09228	A	17400	2	Petromat	$ 0.40
X1	21200	500	100	20700	400	2	2	0.04324	A		2		
X2	6400	650	350	5750	300	2	2	0.08469	A		2		
X3	4100	125	40	3975	85	2	2	0.01277	A	95040	2		
X4	8000	600	125	7400	475			0.00782	A	15000	2		

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Overlay and Fabric Thickness Positioning

Contract#	Thickness of Bituminous Overlay Lifts (in): Prior to most recent rehabilitation	Used in most recent rehabilitation: 1st Lift Binder	Used in most recent rehabilitation: 2nd Lift Binder	Used in most recent rehabilitation: Surface	Vertical Position of Crack Control Treatment: Top of Exist Pav.	Vertical Position of Crack Control Treatment: Top of 1st Bind. Lift	Vertical Position of Crack Control Treatment: Other	Overhead Position of Crack Control Treatment: Over Center Line	Overhead Position of Crack Control Treatment: Over Wide. Joint	Overhead Position of Crack Control Treatment: Other	AC Grade Used in Overlay Mixture
34005	3" existing overlay	1.5		1.5		X			X		AC-20
38823	3" existing overlay.			2					X		
42312	Existing overlay	1.25		1.25	X				X		
60016	Existing overlay			1.5	X						
64126	Existing overlay. Rotomilled profile only.			1.75	X				X		AC-10
80230	3" existing overlay	1.5		1.5		X			X		AC-20
80238	3" existing overlay			1.5	X				X		AC-20
80635											
80677	3" existing overlay			1.5	X				X		AC-20
80903											
82471	Existing overlay. 1 1/2" milling of surface.	0.75		1.5		X					
82845	8" existing overlay. 1 1/2" milling of surface.			1.5	X			X	X	Long. Joints	
82855				1.5	X				X		
82913											
84469	Existing overlay	0.75		1.5		X					AC-10
84484	Existing overlay. Milled 2" on surface.	0.75		1.5		X			X		AC-10
84509	" existing overlay.	1	1.5	1.5		X			X		AC-10
84579	None.	1		1.5							Poly.*
84681	Existing overlay	1.25		1.5	X				X		AC-10
84698	14" existing overaly.	0.75	1.5	1.5		X			X		AC-10
84699	Existing overlay	0.75		1.5		X				Edge	
84785	Existing overlay				X				X		AC-10
84832	" existing overlay.	1.75		1.5	X			X			AC-20
84837	" existing overlay.	1.75		1.5				X			AC-20
84997	Existing overlay									Edge	AC-20
86102	3.625"existing overlay	1		1.5	X				X		
86102	3.625"existing overlay	1		1.5	X				X		
86139	4.25" existing overlay	1		1.5		X			X		
86199											
86202											
86206											
86230	4.5" existing overlay	0.625		1.375						1' from side	
86278											
86317											
88044	3" existing overlay.	0.75		1.25		X					AC-20
88087	3" existing overlay.			2.25					X		AC-20
88089	6" existing overlay.			2					X		AC-20
88114	2" overlay (1967). 2" overlay (1983).			1.5	X				X		AC-10
88151	3" existing overlay.			2.5					X		AC-10
88152	3" existing overlay.			2.5					X		AC-20

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Overlay and Fabric Thickness Positioning

Contract#	Thickness of Bituminous Overlay Lifts (in): Prior to most recent rehabilitation	Used in most recent rehabilitation: 1st Lift Binder	Used in most recent rehabilitation: 2nd Lift Binder	Used in most recent rehabilitation: Surface	Vertical Position of Crack Control Treatment: Top of Exist. Pav.	Vertical Position of Crack Control Treatment: Top of 1st Bind. Lift	Vertical Position of Crack Control Treatment: Other	Overhead Position of Crack Control Treatment: Over Center Line	Overhead Position of Crack Control Treatment: Over Wide. Joint	Overhead Position of Crack Control Treatment: Other	AC Grade Used in Overlay Mixture
88155	4" existing overlay.	1		1.5		X			X		AC-20
88180	3" existing overlay.	1.25	1.75	1.75		X				Mid. Of lane	AC-20
88183		1.75		1.5					X		AC-10
88195	3" existing overlay.			2.25					X		
88205	3" existing overlay.			2					X		AC-20
88432											AC-20
90274		1		1.5		X		X	X		AC-20
90389	Bituminous BSE CSE widening, 9".	1 to 2		1.5	X				X		AC-20
90405	Existing overlay	1		1.5		X			X		AC-20
90420	Existing overlay	0.75	1.625	1.5		X			X		AC-10
90428	" existing overlay.	0.75		1.5		X			X		AC-20
90441	Existing overlay	2		1.5		X			X		AC-20
90527	" existing overlay.	0.75		1.5		X		X	X		AC-20
90562	Existing overlay	0.75		1.5		X			X		Notes
90595	Existing overlay			1.5	X				X		Both
92274	Existing overlay	1		1.5		X			X		AC-20
92295	Existing overlay	0.75		1.5	X						
92378	Existing overlay	0.75		1.5		X					
92382	Existing overlay	1		1.5		X					
92432	Existing overlay	1		1.5		X					
92440		1		1.5		X					
92444	" existing overlay.	1		1.5		X			X		
92458	Existing overlay	1		1.5		X					
92476		1		1.5		X					
92757	Existing overlay			1.5	X						AC-10
92816	Existing overlay			1.5	X						
94173	3" existing overlay. Widened both sides 9" deep.	0.75		1.5		X			X		AC-20
94220	2" existing overlay.	0.75		1.5		X			X		AC-20
94255	3" existing overlay. Widened both sides 10" deep.	0.75		1.5		X			X		AC-20
94270	Existing overlay	1.75		1.5		X		X	X		AC-20
94331	5.5" and 6.25", total = 11.75"	0.75		1.5		X			X		AC-20
94359	3" existing overlay. Widened both sides 9" deep.	0.75		1.5		X		X	X		AC-20
94435	3" existing overlay. Widened both sides 8" deep.	0.75		1.5		X		X	X		AC-20
94554	3" existing overlay. Widened both sides 9" deep.	0.75		1.5		X		X	X		AC-20
96017	3" existing overlay. 1" milling of surface.	0.75		1.25					X		
96155	6" existing overlay.			1.5	X				X		AC-20
96198	3" existing overlay.			1.5	X						AC-20
96229		1.5	0.75	1.5							AC-20
96238	6" existing overlay.			1.5	X				X		AC-20
96239	3" existing overlay.			1.5	X				X		AC-20
96272	3" existing overlay.			1.5	X				X		AC-20

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Overlay and Fabric Thickness Positioning

Contract#	Thickness of Bituminous Overlay Lifts (in): Prior to most recent rehabilitation	Used in most recent rehabilitation: 1st Lift Binder	Used in most recent rehabilitation: 2nd Lift Binder	Used in most recent rehabilitation: Surface	Vertical Position of Crack Control Treatment: Top of Exist. Pav.	Vertical Position: Top of 1st Bind. Lift	Vertical Position: Other	Overhead Position of Crack Control Treatment: Over Center Line	Overhead Position: Over Wide. Joint	Overhead Position: Other	AC Grade Used in Overlay Mixture
96273	3" existing overlay.			1.5	X				X		AC-20
96286		0.75		1.5	X				X		AC-20
96288	Existing overlay			1.5	X						AC-20
96314		0.75		1.5	X						AC-20
96384	Existing overlay	0.75		1.5							
96403	Existing overlay	0.75		1.5		X					AC-20
96417	3" existing overlay. 2" milling of surface.	0.75		1.5		X			X		AC-20
96514		0.75		1.5		X					AC-20
96539											
96555		1.5		1.5	X				X		AC-20
96660	Existing overlay	0.75		1.5		X					AC-20
96821		1.5		1.5	X				X		AC-20
98126	" existing overlay. 3/4" milling of surface.	1		1.5				X	X		AC-20
98129	" existing overlay.	0.75		1.5	X			X	X		AC-20
98186	" existing overlay. Overlay widened to accomadate 5 lanes.	1.5		1.5					X		AC-20
98187	Existing overlay			1.5					X		AC-20
98199				1.5				X	X		AC-20
98210	Existing overlay	0.75		1.5					X		AC-20
98225	Existing overlay. 1/2" milling of surface.			1.5				X	X		AC-20
98227				1.5				X	X		AC-20
98230	Existing bituminous shoulder.										AC-20
98240	" existing overlay. 1/2" milling of surface.			1.5	X			X	X		AC-20
98255				1.5							AC-20
98268	Existing overlay. 1/2" milling of surface.	1		1.5		X		X	X		AC-20
98269				1.5				X	X		AC-20
98274	Existing overlay. 1/2" milling of surface.			1.5				X	X		AC-20
98288	Existing overlay	0.75		1.5							AC-20
98333				1.5				X	X		AC-20
98338	Existing overlay. 1/2" milling of surface.			1.5	X			X	X		AC-20
98339				1.5	X			X	X		AC-20
98355				1.5	X			X	X		AC-20
98388	None.	1.25		1.25				X	X		AC-20
98400	Existing overlay			1.5	X						AC-20
98402				1.5	X			X	X		AC-20
X1											
X2	Existing overlay			1.5	X						
X3	Existing overlay			1.5	X						
X4	Existing overlay			1.5	X						AC-20

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Contract#	Pre Existing Condition: Type / Condition / Preparation of Existing Pavement Prior to Treatment																			
	Type						Condition, Use CRS Abbreviations or Describe													
				Lane Widening			AC Pavement								PCC Pavement					
	Type of Exist. Pave.	Thick. of Exist. Pave.	Joint Spcg If PCC	Year	Width (ft)	Material	Alligator Cracking	Block Cracking	Rutting	Trans. Cra. Joint Ref. Cr	Long. Cracking	Reflective Wide. Crck	Centerline Deteriaration	Others	D-Cracking	Transverse Cracking	Long. Cracking	Faulting	Centerline Deterioration	Others
34005	PCC	9-6-9			3'BS	AC														
38823	PCC	9"								O			S							
42312	PCC					PCC														
60016	AC																			
64126	PCC				3' B S															
80230	PCC	9-6-9			3'BS	AC														
80238	PCC	9-6-9			3'BS	AC														
80635																				
80677	PCC	9-6-9			3'BS	AC														
80903																				
82471	AC					AC														
82845	PCC	9"				AC														
82855	PCC					PCC														
82913																				
84469	PCC		18'		2' B S	AC														
84484																				
84509	PCC																			
84579	PCC	10"																		
84681	PCC																			
84698	PCC																			
84699	PCC																			
84785	PCC																			
84832	PCC																			
84837	PCC													X2						
84997	PCC																			
86102	PCC	9-6-9			4' BS	AC														
86102	PCC	9-6-9			4' BS	AC														
86139	PCC	9-6-9		1971	4'BS	AC														
86199																				
86202																				
86206																				
86230	PCC			1974	3'BS	AC														
86278																				
86317																				
88044	PCC				3'BS	AC		M		O	Q		S							
88087	PCC	10"				AC				O			S							
88089	JPCP		18'		2' B S					O	Q		S							
88114	PCC				4' BS	AC		M	N	O			S							
88151	JPCP				2' tot.				N				S	T						
88152	JPCP				4' tot.	AC			N	O			S							

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Contract#	Pre Existing Condition: Type / Condition / Preparation of Existing Pavement Prior to Treatment — Type: Type of Exist. Pave.	Type: Thick. of Exist. Pave.	Type: Joint Spcg If PCC	Type: Lane Widening: Year	Type: Lane Widening: Width (ft)	Type: Lane Widening: Material	Condition, Use CRS Abbreviations or Describe — AC Pavement: Alligator Cracking	AC Pavement: Block Cracking	AC Pavement: Rutting	AC Pavement: Trans. Cra. Joint Ref. Cr	AC Pavement: Long. Cracking	AC Pavement: Reflective Wide. Crck	AC Pavement: Centerline Deteriaration	AC Pavement: Others	PCC Pavement: D-Cracking	PCC Pavement: Transverse Cracking	PCC Pavement: Long. Cracking	PCC Pavement: Faulting	PCC Pavement: Centerline Deterioration	PCC Pavement: Others
88155	PCC				4' BS	AC	L	M		O			S	T						
88180	CRCP	7"						M	N											
88183	PCC				3' tot.	AC				O			S							
88195	JPCP				4' tot.	AC				O			S	T						
88205	PCC				2' tot.	AC			N	O		R	S							
88432									N	O		R	S	V						
90274	PCC	9"				AC								X						
90389	PCC	9-6-9				AC														
90405	PCC					AC								X						
90420	PCC					PCC/ AC								X3						
90428	PCC																			
90441	PCC																			
90527	PCC								N											
90562	PCC																			
90595	PCC													X						
92274	PCC				4'BS															
92295	PCC																			
92378	PCC				3'BS															
92382	PCC				4'BS															
92432	PCC				3'BS															
92440																				
92444	PCC				2' tot.	AC														
92458	PCC				3'BS															
92476					4'BS															
92757	PCC																			
92816	PCC				2'BS															
94173	PCC	9-6-9			3' B S	AC														
94220	PCC																			
94255	PCC	9-6-9			2' B S	AC														
94270	CRCP	8"												X3						
94331	PCC	9-6-9			3' B S	AC														
94359	PCC	9-6-9			B S	AC														
94435	PCC	9-6-9			3' B S	AC														
94554	PCC	9-6-9			3' B S.	AC														
96017	PCC	9-6-9				PCC														
96155	JPCP					PCC														
96198	PCC	9-7-9				PCC			N	O3										
96229	PCC	9-7-9			3' B S	AC														
96238	JPCP					AC														
96239	JPCP					AC														
96272	JPCP					AC														

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Contract#	Pre Existing Condition: Type / Condition / Preparation of Existing Pavement Prior to Treatment — Type						Condition, Use CRS Abbreviations or Describe — AC Pavement								PCC Pavement					
				Lane Widening																
	Type of Exist. Pave.	Thick. of Exist. Pave.	Joint Spcg If PCC	Year	Width (ft)	Material	Alligator Cracking	Block Cracking	Rutting	Trans. Cra. Joint Ref. Cr	Long. Cracking	Reflective Wide. Crck	Centerline Deteriaration	Others	D-Cracking	Transverse Cracking	Long. Cracking	Faulting	Centerline Deterioration	Others
96273	JPCP					AC														
96286	JRCP				3' B S	AC														
96288	PCC					AC														
96314	PCC	9-7-9			B S	AC														
96384	PCC				2' B S															
96403	PCC				3' B S															
96417	PCC				4' B S	AC			N											
96514	PCC																			
96539	PCC	10-8-10																		
96555	JCP	9-6-9			3' B S															
96660	PCC				3' B S															
96821	JCP	9-6-9			3' B S															
98126	PCC																			
98129	PCC																			
98186	PCC																			
98187	PCC																			
98199																				
98210	PCC																			
98225	PCC																			
98227																				
98230	AC																			
98240	PCC																			
98255																				
98268	PCC																			
98269																				
98274	PCC																			
98288	PCC																			
98333																				
98338	PCC																			
98339	PCC																			
98355	PCC																			
98388	PCC																			
98400	PCC																			
98402	PCC																			
X1																				
X2	JCP	9-6-9			2' B S	PCC														
X3	PCC				1.5' B S	AC														
X4	PCC	9-7-9			3' B S	AC														

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Maintenance & Rehabilitation Reported in Surveys																			
	Prior to Treatment Preparation				Crack Sealing Since Overlay						Subsequent AC Overlay				Other Maintenance or Rehabilitation				
					1st			2nd											
Contract#	Crack Sealing	Rotomilling	Full / Partial PCC /AC patch	Other	Year	Ln. Ft.	$ / ft.	Year	Ln. Ft.	$ / ft.	Thickness	Year	Quantity (Tons)	$ / Ton	Type	Year	Quantity	Quantity Unit (e.g. ft)	Unit Price
34005															Minor liquid sealing				
38823																			
42312	None	X										None			None				
60016	X	X	PA		None			None				None			None				
64126		X																	
80230																			
80238																			
80635																			
80677																			
80903																			
82471		X																	
82845		X																	
82855		X			None						None				None				
82913																			
84469																			
84484		X																	
84509																			
84579																			
84681																			
84698																			
84699																			
84785																			
84832		X																	
84837																			
84997		X																	
86102																			
86102																			
86139																			
86199																			
86202																			
86206																			
86230																			
86278																			
86317																			
88044					1991														
88087																			
88089																			
88114																			
88151																			
88152																			

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Maintenance & Rehabilitation Reported in Surveys																			
	Prior to Treatment Preparation				Crack Sealing Since Overlay						Subsequent AC Overlay				Other Maintenance or Rehabilitation				
					1st			2nd											
Contract#	Crack Sealing	Rotomilling	Full / Partial PCC /AC patch	Other	Year	Ln. Ft.	$ / ft.	Year	Ln. Ft.	$ / ft.	Thickness	Year	Quantity (Tons)	$ / Ton	Type	Year	Quantity	Quantity Unit (e.g. ft)	Unit Price
88155																			
88180																			
88183	None														None				
88195																			
88205					95	94,925	0.38								None				
88432																			
90274	None		FA												None				
90389	None		F	Cln. & Fill											None				
90405	X		FP & PA	Clean	96	11,200	0.52	97	12,062	0.52					None				
90420	None		F												None				
90428			FP & FA	Cln. & Fill															
90441	X		FA	Cln. & Fill	97	9,012	0.72					None			None				
90527	X				96	58,092	0.47	Same	36,200	0.64									
90562	X	X			96	15,700	0.53	97	53,000			None			None				
90595	X		None		97	16,812	0.72					None			None				
92274		X																	
92295		X																	
92378		X	F																
92382		X	F																
92432			F																
92440		X	F																
92444		X	F																
92458			F																
92476			F																
92757		X																	
92816		X	F																
94173	None											None			None				
94220	X		A																
94255	X					50						None							
94270	None	X	FP, PA									None							
94331																			
94359	None											None			None				
94435	X					350						None							
94554	None											None			None				
96017		X																	
96155		X	F																
96198	None	X	F												None				
96229		X	F																
96238		X	F												None				
96239		X	F																
96272		X	F												None				

Table C1. Second Surveys (All Data) - Strip Treatment (Continued)

Maintenance & Rehabilitation Reported in Surveys

Contract#	Prior to Treatment Preparation				Crack Sealing Since Overlay 1st			Crack Sealing Since Overlay 2nd			Subsequent AC Overlay				Other Maintenance or Rehabilitation				
	Crack Sealing	Rotomilling	Full / Partial PCC /AC patch	Other	Year	Ln. Ft	$ / ft.	Year	Ln. Ft	$ / ft.	Thickness	Year	Quantity (Tons)	$ / Ton	Type	Year	Quantity	Quantity Unit (e.g. ft)	Unit Price
96273		X	F																
96286			F																
96288		X	F																
96314			F																
96384	None	X	F												None				
96403	None	X	F												None				
96417	X	X																	
96514		X	F																
96539																			
96555			A																
96660	None	X	F												None				
96821			A																
98126		X																	
98129																			
98186																			
98187	None											None			None				
98199	None											None			None				
98210	None											None			None				
98225	None	X										None			None				
98227	None											None			None				
98230	None											None			None				
98240		X																	
98255	None											None			None				
98268	None	X										None			None				
98269	None											None			None				
98274	None	X										None			None				
98288	None	X										None			None				
98333	None											None			None				
98338	None	X										None			None				
98339	None											None			None				
98355	None											None			None				
98388	None		P									None			None				
98400	None	X										None			None				
98402	None											None			None				
X1																			
X2		X																	
X3	None	X										None							
X4		X																	

Table C2. Second Surveys (All Data) - Area Treatment

Job Description									
Contract#	District	Zone	Date Let			Brief Job Description	Date Completed		
			Month	Date	Year		Month	Date	Year
40229	4	2			85	FA 53. U.S. 136. McDonough			86
60088	1	1				Wolf Rd. from North Ave. to Withors. Northlake, IL.	7	11	97
64048	2	1				IL Rte. 81 West of Kewanee.	10		96
64131	2	1				IL Rte. 251 South of Rochelle.	10		96
84995	2	1				IL Rte. 251 North of U.S. 30.	11		95
86139	3	2				FA 681 116 RS and 117 RS-1 Iroquois County, Resurfacing IL 116 from 2.68 mi. east of Ford-Iroquois County Line to Ashkum	11	13	91
86221	3	2				FAS 323 [(5,68,69,104,116,) - 15] Iroquois County Rehab Woodland Rd. from IL 49 to west edge of Woodland.	7	2	92
86266	3	2				FA 730 Alt. (56 A, 8CS) RS-1 Mc Lean County Milling and resurfacing on US 51 NB in Bloomington	1	15	92
87045	3	2				FAS 478 91-00113-02-RS Mc Lean County, 5.2 mile RS and AG6, SHILDS on Towanda Rd. from IL 9 to Towanda	10	6	92
88019	4	2				FA 685 IL 9. E. of IL 41 Junction.			88
88195	4	2			93	IL Rte. 17 and 180. Surfacers Inc.	10	19	93
88205	4	2			92	IL Rte. 94 and 17. Surfacers Inc.			92
88211	4	2			95	IL Rte. 40	10	10	96
88262	4	2			93	U.S. Rte. 67. South to North of Good Hope.	6	15	95
88271	4	2			94	IL Rte. 17. IL 88 and South of Camp Grove to Sparland.	5	22	96
88353	4	2			94	IL Rte. 90 and 91. Princeville East to East intersection of IL Rte. 90 and 91.	9	27	95
88498	4	2			96	IL 135, US Rte. 67 to Alexis.	9	12	96
88621	4	2			94	U.S. Rte. 150. IL 74 to Jubilee Park.	10	19	95
88678	4	2			96	IL Rte. 122. Hopedale to 3 miles W. of Minier.	10	1	96
92696	6	2				Resurfacing on Spresser from IL 48 to Cheney street in Taylorville	10	2	96
92766	6	2				US 66 from IL 10 in Lincoln to Salt Creek S. of Lincoln			94
93061	6	2				Chestnut street from 8 th to 12 th streets in Quincy	1	26	93
93168	6	2				FAS Route 461 from Manito Southwesterly to 1 mile N.E. of Forest City	8	7	95
95135	7	3				On FAS 806 Bridgeport Road.	9	19	94
95153	7	3				On FAS 819 Texico to CH2.	10	24	94
95154	7	3				On FAS 822 Mt. Vernon Road. FAS 819 to 820.	10	24	94
96539	8	3				IL 111 from Pontoon Rd. to Chain of Rocks Rd. in Pontoon Beach.			94
98126	9	3	10	11	91	Ill.146 Widen & Resurface			
98193	9	3	10	14	94	Illinois 13 from Fair St. to Old Rt. 13			
98194	9	3	5	6	96	Illinois 13 Section (6Z)R			
98196	9	3	1	14	94	Ill. 166 from Creal Springs to U.S. 45			
98199	9	3	5	20	94	IL 13 in H'Burg.			
98201	9	3	7	10	92	Illinois 13 in Marion & Various			
98210	9	3	1	14	94	Ill 151 from Ill.3 to Ill.4 in Ava			
98278	9	3	10	6	95	U.S. 51 Middle Relocation in Union Co.			96
98282	9	3	4	12	96	Illinois 13 De Young Street in Marion			
98286	9	3	7	12	96	Old Illinois 13 in Marion (Main St.)			
98333	9	3	8	26	94	IL 154			
98360	9	3	8	25	95	IL 13 in Marion			
98402	9	3				IL 13			

Table C2. Second Surveys (All Data) - Area Treatment (Continued)

Traffic									Materials			
Contract#	ADT	Ave. Hea. Daily Com. Traf.	Ave. Multi. Uni. Daily Traf.	PV	SU	Number of Lanes	Road's Class	TF (Traffic Factor)	Treatment Type A, B, or C	Quantity of Crack Control Treatment (sq. yd.)	Brand Name For Strip Treatment (If applied)	Unit Price of Treatment $ / sq. yd.
40229	4450	450	375	4000	75	2	2	0.07677	A	25820	Phillips Fiber	
60088	12200	---	---			---			A	45000	Petromat	$ 0.65
64048	1850	150	50	1700	100	2	3	0.01519	A	91752	Amoco 4598	$ 0.65
64131	5200	150	100	5050	50	2	2	0.02245	A	85996	AmoPave	$ 0.60
84995	1900	150	100	1750	50	2	3	0.02208	A	67269	AmoPave	$ 0.75
86139	1950	150	150	1800	0	2	3	0.02896	A	84267	Spartan Technology	$ 0.76
86221	950	100	40	850	3	2	3	0.00791	A	12614	Spartan Technology	
86266	17500	850	400	16650	450	2	2	0.10355	A	14803	Phillips Fiber Corp	$ 1.55
87045	3500	100	75	3400	25	2	2	0.01611	A	72670		$ 0.52
88019	875	125	60	750	65	2	3	0.01513	A	14280	Phillips Fiber	
88195	1000	60	20	940	40	2	3	0.0061	A	102963	American Oil	$ 1.10
88205	4900	250	125	4650	125	2	2	0.03144	A	62069	American Oil	$ 1.00
88211	1750	200	125	1550	75	2	3	0.02823	A	93086	AmoPave	$ 0.68
88262	4500	850	475	3650	375	2	2	0.11283	A	26896	AmoPave 4598	$ 0.85
88271	1350	175	125	1175	50	2	3	0.02684	A	141142	AmoPave 4598	$ 0.71
88353	3550	250	125	3300	125	2	2	0.03134	A	67634	Polyfelt	$ 0.80
88498	1600	350	175	1250	175	2	3	0.04327	A	23955	AmoPave 4598	$ 0.90
88621	3400	250	30	3150	220	2	2	0.01834	A	153921	AmoPave 4598	$ 0.70
88678	2100	80	40	2020	40	2	2	0.0101	A	49961	AmoPave 4598	$ 1.10
92696	7400	180	150	7220	30	2	2	0.03113	A	36216	Amoco 4599 & 4598	$ 0.76
92766	5700	180	95	5520	85	4	1	0.02607	A	12771	Amoco 4599 & 4598	$ 1.12
93061	4700	160	100	4540	60	2 driv.+2 park.	2	0.02297	A	7851	Amoco	$ 1.63
93168	5200	260	260	4940	0	2	2	0.05048	A	31365	Amoco 4598	$ 1.85
95135	900	75	10	825	65	2	3	0.00553	A	73333	Polyfelt PGM 15	$ 0.61
95153	850	100	10	750	90	2	3	0.00689	A	45402	Amoco Pave	$ 0.80
95154	1050	120	5	930	115	2	3	0.00731	A	69598	AmoPave	$ 0.82
96539	15100	900	350	14200	550	4	1	0.10975	A	2400		
98126	1950	150	50	1800	100	2	3	0.0152	A	29340	Petromat	
98193	12500	1000	750	11500	250	4	1	0.17854	A	21098	Petromat	$ 1.22
98194	12500	1000	750	11500	250	4	1	0.17854	A	20620	Petromat	$ 1.32
98196	1250	75	30	1175	45	2	3	0.00831	A	68168	Petromat	$ 0.76
98199	17200	850	450	16350	400	2	2	0.11036	A	30400	Petromat	$ 0.80
98201	30600	1450	850	29150	600	4	1	0.22231	A	18458	Petromat	$ 1.00
98210	1100	80	40	1020	40	2	3	0.00995	A	9629	Petromat	$ 1.18
98278	4750	300	150	4450	150	2	2	0.03765	A	12234	Petromat	$ 0.68
98282	12500	1000	750	11500	250	4	1	0.17854	A	10575	Petromat	$ 1.65
98286	15500					2	2	0	A	12600	Petromat	$ 1.10
98333	3750		175			2	2	0.03373	A	22837	Petromat	$ 0.80
98360	23100	1450	850	21650	600	2 & 4	1	0.2218	A	14688	Petromat	$ 1.10
98402	15300		425	15300		2 & 4	1	0.09332	A	23630	Petromat	$ 0.95

Table C2. Second Surveys (All Data) - Area Treatment (Continued)

Overlay and Fabric Thickness Positioning								
Contract#	Thickness of Bituminous Overlay Lifts (in)				Position of Crack Control Treatment			AC Grade Used in Overlay Mixture
	Prior to most recent rehabilitation	Used in most recent rehabilitation						
		1st Lift Binder	2nd Lift Binder	Surface	Top of Exist. Pav.	Top of 1st Bind. Lift.	Other	
40229	3" existing overlay.	2	0.75	1.25		X		AC 70-85
60088	Existing overlay. Last resurfaced in 1987.	0.75		1.5		X		
64048	Existing overlay.	1.25		1.25	X			AC-10
64131	Existing overlay.	1.5		1.5	X			
84995	4" existing overlay.			3	X			AC-10
86139	5.375" existing overlay	1		1.5		X		
86221								
86266								
87045								
88019	3" existing overlay.	0.75		1.25	X			AC-10
88195	3" existing overlay.			2.25				AC-10
88205	3" existing overlay.			2				AC-20
88211	3" existing overlay.			2.25				AC-20
88262	3" existing overlay.			2.5				AC-20
88271	3" existing overlay.			2.25				AC-20
88353	3" existing overlay.			2.25				AC-20
88498	3" existing overlay.			2				AC-20
88621	6" existing overlay.			1.5				AC-10
88678	3" existing overlay.			2				AC-20
92696		1.75		1.5		X		AC-10
92766	"existing overlay	0.75		1.5	X			
93061	"existing overlay	1.5		1.5	X			
93168	"existing overlay	1.5		1.5	X			
95135	4" existing overlay	0.75	1.5	1.5				
95153	xisting 1" surface over 1 1/2" binder over 7" soil cement base	0.75		2.5		X		AC-10
95154	Existing 1" surface over 1 1/2" binder over 7" soil cement ba	0.75		2.5		X		AC-10
96539								
98126	" existing overlay.	2	2	1.5		X		AC-20
98193	" existing overlay.	2.75		1.5	X			AC-20
98194	Existing overlyay.	1.25		1.5	X			AC-20
98196	Existing overlyay.	1.5		2				AC-20
98199	Existing overlay. 1/2" milling of surface.			1.5		X		AC-20
98201				1.5	X			AC-20
98210	" existing overlay.	0.75		1.5		X		AC-20
98278	" existing overlay.	1.5		1.5				AC-20
98282	None.	1.75		1.5	X			AC-20
98286		0.75		1.5				AC-20
98333				1.5				AC-20
98360		0.75		1.5	X			AC-20
98402				1.5				AC-20

Table C2. Second Surveys (All Data) - Area Treatment (Continued)

Pre Existing Condition																				
	Type / Condition / Preparation of Existing Pavement Prior to Treatment																			
	Type						Condition, Use CRS Abbreviations or Describe													
				Lane Widening			AC Pavement								PCC Pavement					
Contract#	Type of Exist. Pave.	Thick. of Exist. Pave.	Joint Spcg if PCC	Year	Width (ft)	Material	Alligator Cracking	Block Cracking	Rutting	Trans. Cra. Joint Ref. Cr	Long. Cracking	Reflective Wide. Crck	Centerline Deterioration	Others	D-Cracking	Transverse Cracking	Long. Cracking	Faulting	Centerline Deterioration	Others
40229	PCC	9-6-9			3' BS	AC				O		R	S	T						
60088	AC																			
64048	PCC																			
64131	PCC																			
84995	PCC																			
86139	PCC	9-6-9		1960 and 19	4'BS	AC														
86221																				
86266																				
87045																				
88019	PCC	9-6-9						M		O			S							
88195	JCP				4' tot.	AC	L	M		O			S	T						
88205	PCC				2' BS	AC			N	O		R	S							
88211	JCP				3' tot.	AC		M		O		R	S							
88262	JCP					AC				O			S	V						
88271	JCP				4' tot.	AC		M	N	O	Q	R								
88353	JCP				4' tot.	AC		M		O	Q	R	S							
88498	JCP				4' tot.	AC		M		O		R	S							
88621	PCC				4' BS	AC		M			Q	R	S							
88678	JCP				4' tot.	AC		M		O		R	S							
92696	PCC				3'															
92766	PCC													Medium Cracking						
93061	PCC																			
93168	AC													Some Cracking						
95135	AC	4"			2.5 B S	AC														
95153	Soil Ce	7"					L2													
95154	PCC	7"					L2													
96539	PCC	0-8-10																		
98126	PCC																			
98193	PCC																			
98194	PCC																			
98196	PCC				3' B S															
98199	PCC																			
98201																				
98210	PCC																			
98278	PCC																			
98282	PCC																			
98286	PCC					PCC														
98333	---																			
98360	PCC																			
98402																				

Table C2. Second Surveys (All Data) - Area Treatment (Continued)

Maintenance & Rehabilitation Reported in Surveys																			
	Prior to Treatment Preparation				Crack Sealing Since Overlay						Subsequent AC Overlay				Other Meintenance or Rehabilitation				
					1st			2nd											
Contract#	Crack Sealing	Rotomilling	Full / Par. PCC patch	Miscellaneous	Year	Ln. Ft.	$ / ft.	Year	Ln. Ft.	$ / ft.	Thickness	Year	Quantity (Tons)	$ / Ton	Type	Year	Quantity	Quantity Unit (e.g. ft)	Unit Price
40229																			
60088	None											None			None				
64048		X																	
64131		X																	
84995		X																	
86139																			
86221																			
86266																			
87045																			
88019											1.5	1993							
88195																			
88205	X				1995	####	0.38												
88211																			
88262	None														None				
88271																			
88353																			
88498	None														None				
88621																			
88678																			
92696																			
92766		X																	
93061																			
93168																			
95135			FA																
95153																			
95154	None											None			None				
96539																			
98126																			
98193			PA																
98194	None											None			None				
98196	None											None			None				
98199	None	X										None			None				
98201																			
98210																			
98278																			
98282	None		PA									None			None				
98286	None											None			None				
98333	None											None			None				
98360	None		PA									None			None				
98402	None											None			None				

Table C3. Second Surveys (All Data) - Control Sections

Job Descriptions									
Contract#	District	Zone	Date Let			Brief Job Description	Date Completed		
			Month	Date	Year		Month	Date	Year
40229	4	2				FA 53. U.S. 136. McDonough			86
84995	2	1				IL 251 South of US 30.	10		95
86102	3	2				IL 178 from IL Southeast of Oglesby South to Lowell	9	17	90
88019	4	2				FA 685 IL 9 McDonough			93
88044	4	2				US 34 South of Kirkwood to South of Gladstone			88
90527	5	2				IL Rte. 130 from Camargo to Philo. The south portion of this contract, from Villa Grove to Camargo was not treated.	9	27	95
92766	6	2				Resurfacing on old US 66 from IL 10 in Lincoln to Salt Creek S. of Lincoln. From station 4+50 North to 72+00 Southerly only the turn lanes were done. From 72+00 to 85+00 the driving lanes were done.	8	24	95
96384	8	3				IL Rte. 4/13 from Marissa to Tilden			93
96539	8	3				IL 111 from Pontoon Rd. to Chain of Rocks Rd. in Pontoon Beach.			94

Table C3. Second Surveys (All Data) - Control Sections (Continued)

Traffic								
Contract#	ADT	Ave. Hea. Daily Com. Traf.	Ave. Multi. Uni. Daily Traf.	PV	SU	Number of Lanes	Road's Class	TF (Traffic Factor)
40229	4450	450	375	4000	75	2	2	0.076772
84995	1200	80	60	1120	20	2	3	0.012706
86102	3850	500	325	3350	175	2	2	0.072691
88019	875	125	60	750	65	2	3	0.015134
88044	4200	1100	1000	3100	100	2	2	0.198556
90527	4000	100	70	3900	30	2	2	0.015464
92766	5700	180	95	5520	85	4	1	0.026069
96384	6300	275	150	6025	125	2	2	0.036364
96539	15100	900	350	14200	550	4	1	0.109751

Table C3. Second Surveys (All Data) - Control Sections (Continued)

Overlay and Existing Pavement											
Contract#	Thickness of Bituminous Overlay Lifts (in)				AC Grade Used in Overlay Mixture	Existing Pavement Prior to Treatment					
	Prior to most recent rehabilitation	Used in most recent rehabilitation				Type			Lane Widening		
		1st Lift Binder	2nd Lift Binder	Surface		Type of Exist. Pave.	Thick. of Exist. Pave.	Joint Spcg if PCC	Year	Width (ft)	Material
40229	3" existing overlay.	2	0.75	1.25	AC-70	PCC	9-6-9			3' BS	AC
84995	4 " existing overlay.			1.5	AC-10	PCC					
86102	3.625" existing overlay.	1		1.5		PCC	9-6-9			4' BS	AC
88019	3" existing overlay.	0.75		1.25	AC-10	PCC	9-6-9				
88044	3" existing overlay.	0.75		1.25	AC-20	PCC				3'BS	AC
90527	" existing overlay.	0.75		1.5	AC-20	PCC					
92766	" existing overlay	0.75		1.5		PCC					
96384	" existing overlay.	0.75		1.5		PCC				2 BS	AC
96539						PCC	10-8-10				

Table C3. Second Surveys (All Data) - Control Sections (Continued)

Contract#	Pre Existing Condition													
	Type / Condition / Preparation of Existing Pavement Prior to Treatment													
	Condition, Use CRS Abbreviations or Describe													
	AC Pavement								PCC Pavement					
	Alligator Cracking	Block Cracking	Rutting	Trans. Cra. Joint Ref. Cr	Long. Cracking	Reflective Wide. Crck	Centerline Deteriaration	Others	D-Cracking	Transverse Cracking	Long. Cracking	Faulting	Centerline Deterioration	Others
40229														
84995														
86102														
88019		M		O			S							
88044		M		O	Q		S							
90527														
92766														
96384														
96539														

Table C3. Second Surveys (All Data) - Control Sections (Continued)

Maintenance & Rehabilitation Reported in Surveys

Contract#	Preparation				Crack Sealing Since Overlay: 1st			Crack Sealing Since Overlay: 2nd			Subsequent AC Overlay				Other Meintenance or Rehabilitation				
	Type of Exist. Pave.	Rotomilling	Full / Par. PCC patch	Miscellaneous	Year	Ln. Ft.	$ / ft.	Year	Ln. Ft.	$ / ft.	Thickness	Year	Quantity (Tons)	$ / Ton	Type	Year	Quantity	Quantity Unit (e.g. ft)	Unit Price
40229		X			89														
84995			FA																
86102																			
88019																			
88044					90			91											
90527																			
92766																			
96384		X	F																
96539																			

Appendix D

(Crack Mapping)

Location/Description: IL 251 North of US 30 (Area Treated Section)

Date: 6/25/98 (Note: Crack widths indicated on survey are given in mm.)

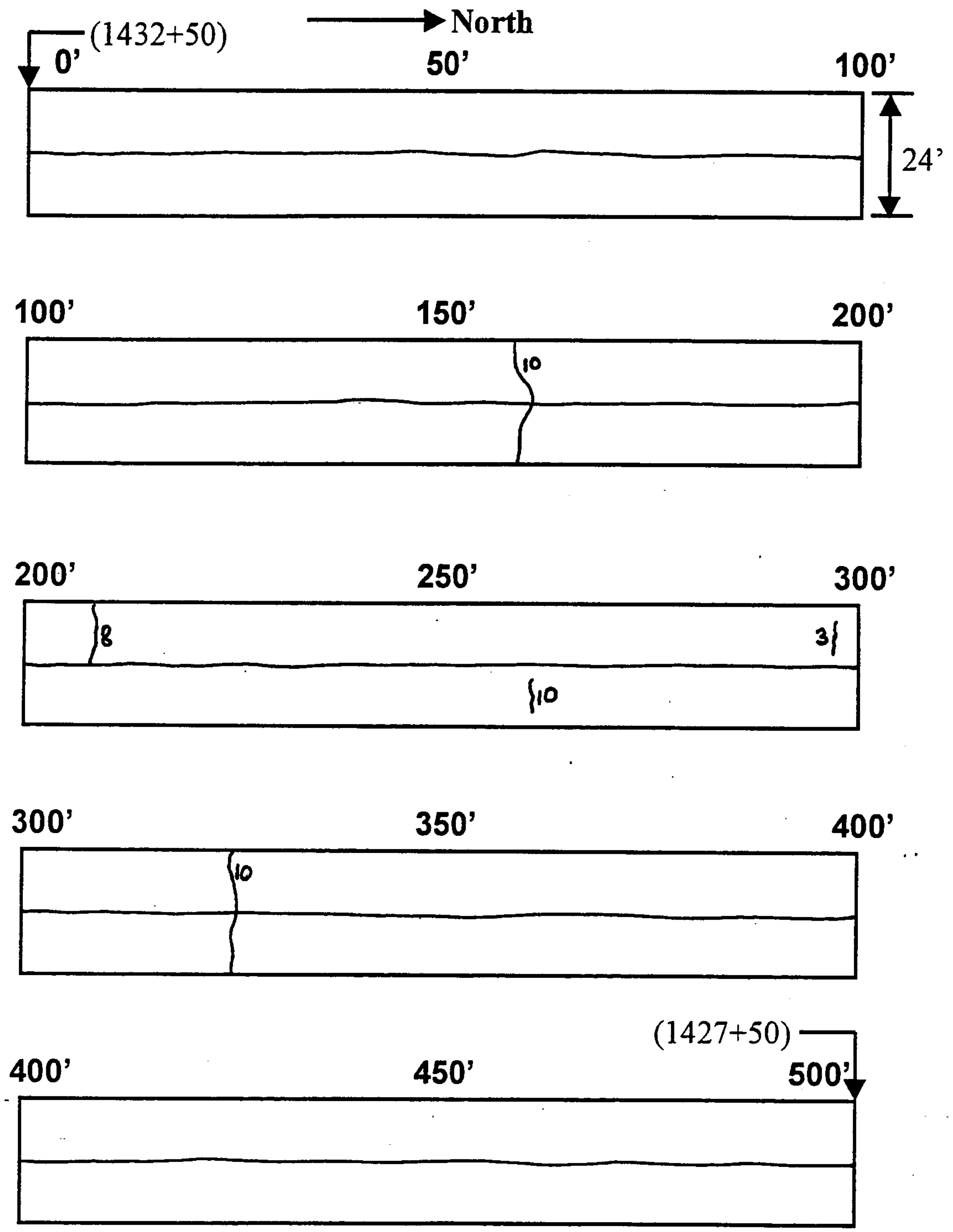

Figure D1. Crack Survey for IL 251

Location/Description: IL 251 South of US 30 (Control Section)

Date: 6/25/98 (Note: Crack widths indicated on survey are given in mm.)

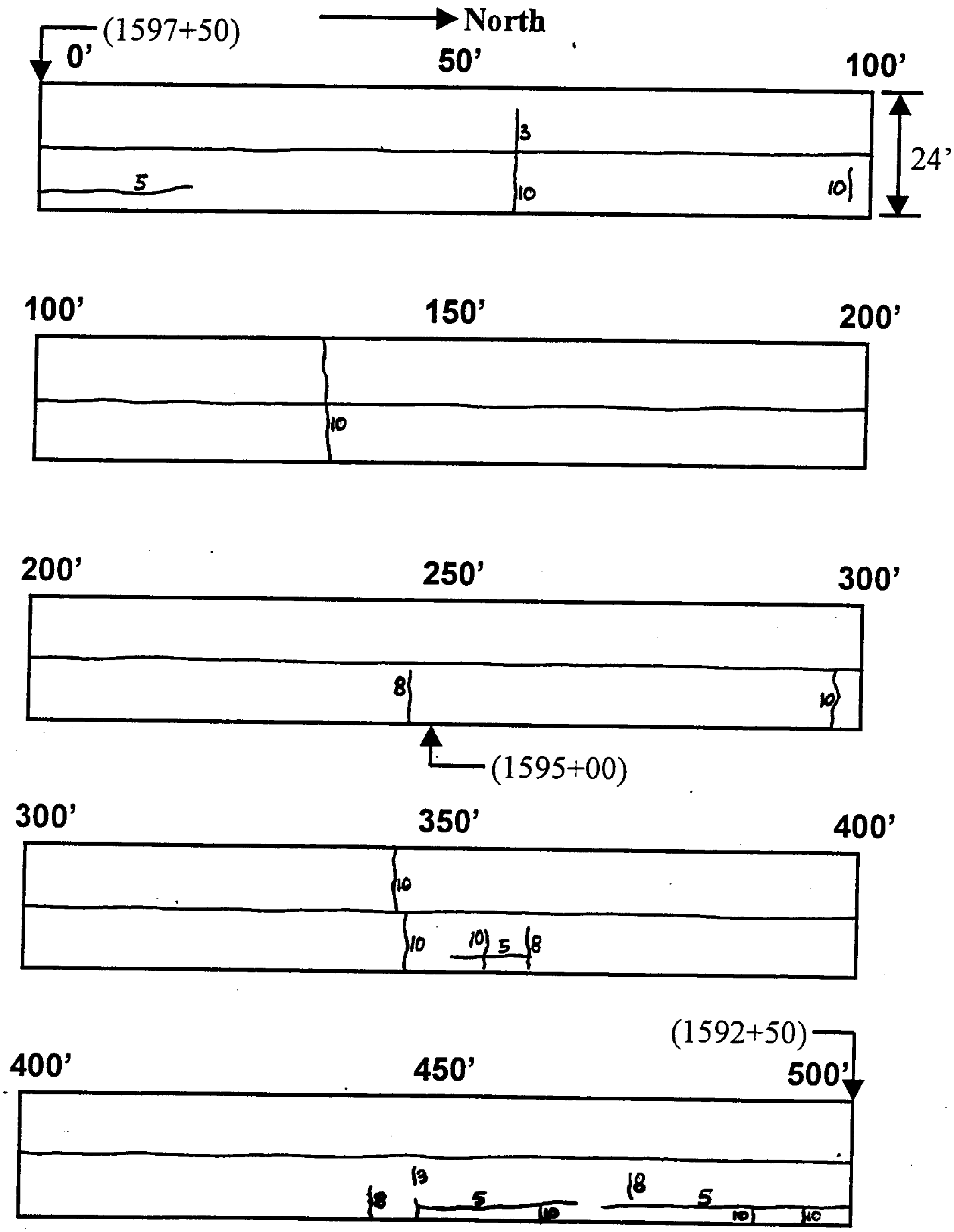

Figure D2. Crack Survey for IL 251

Location/Description: IL178 (Strip Treated Section)

Date:6/25/98 (Note: Crack widths indicated on survey are given in mm.)

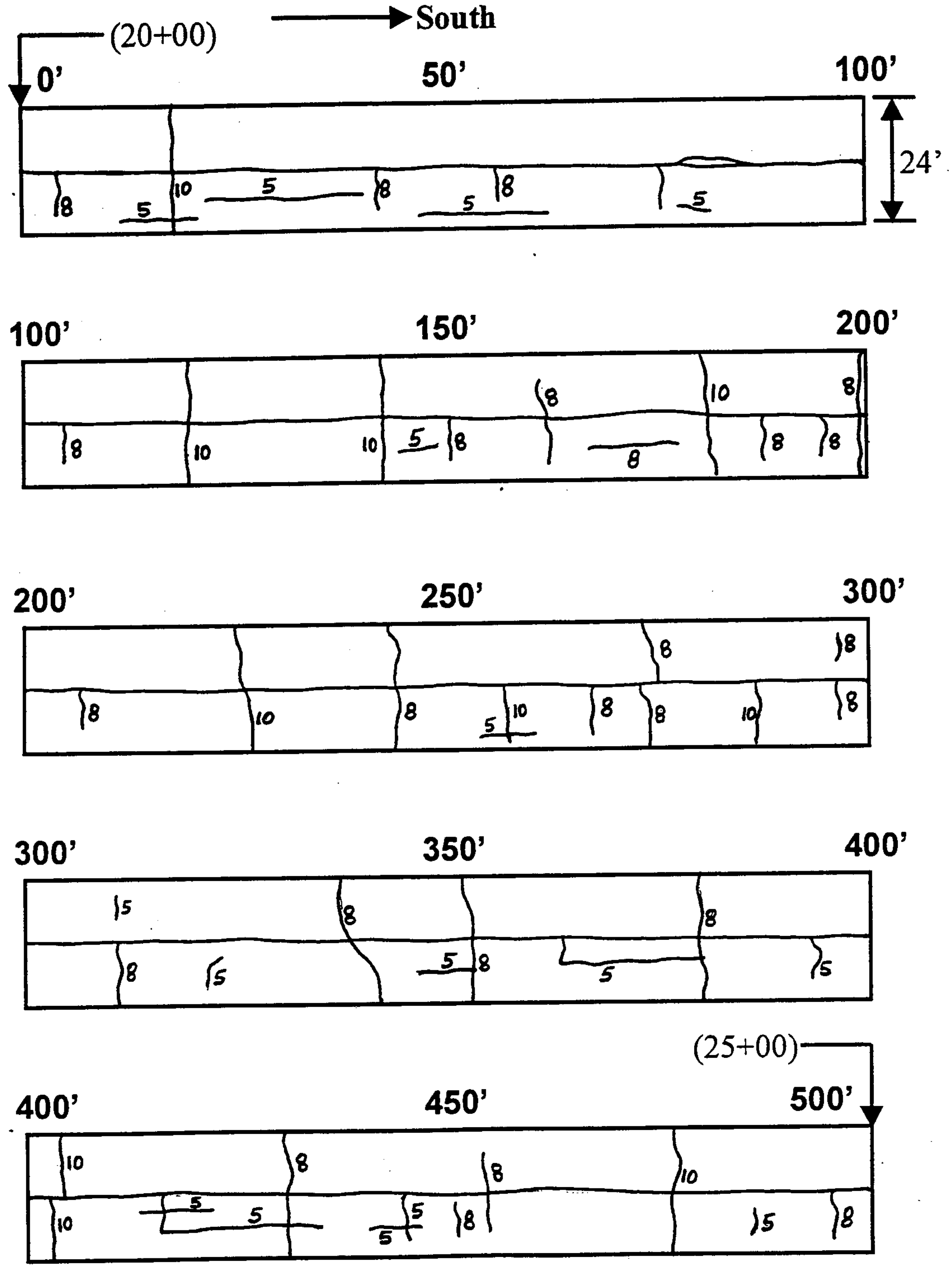

Figure D3. Crack Survey for IL 178

Location/Description: IL 178 South of IL 71 Junction

(425' Control Section) Date:6/25/98

(Note: Crack widths indicated on survey are given in mm.)

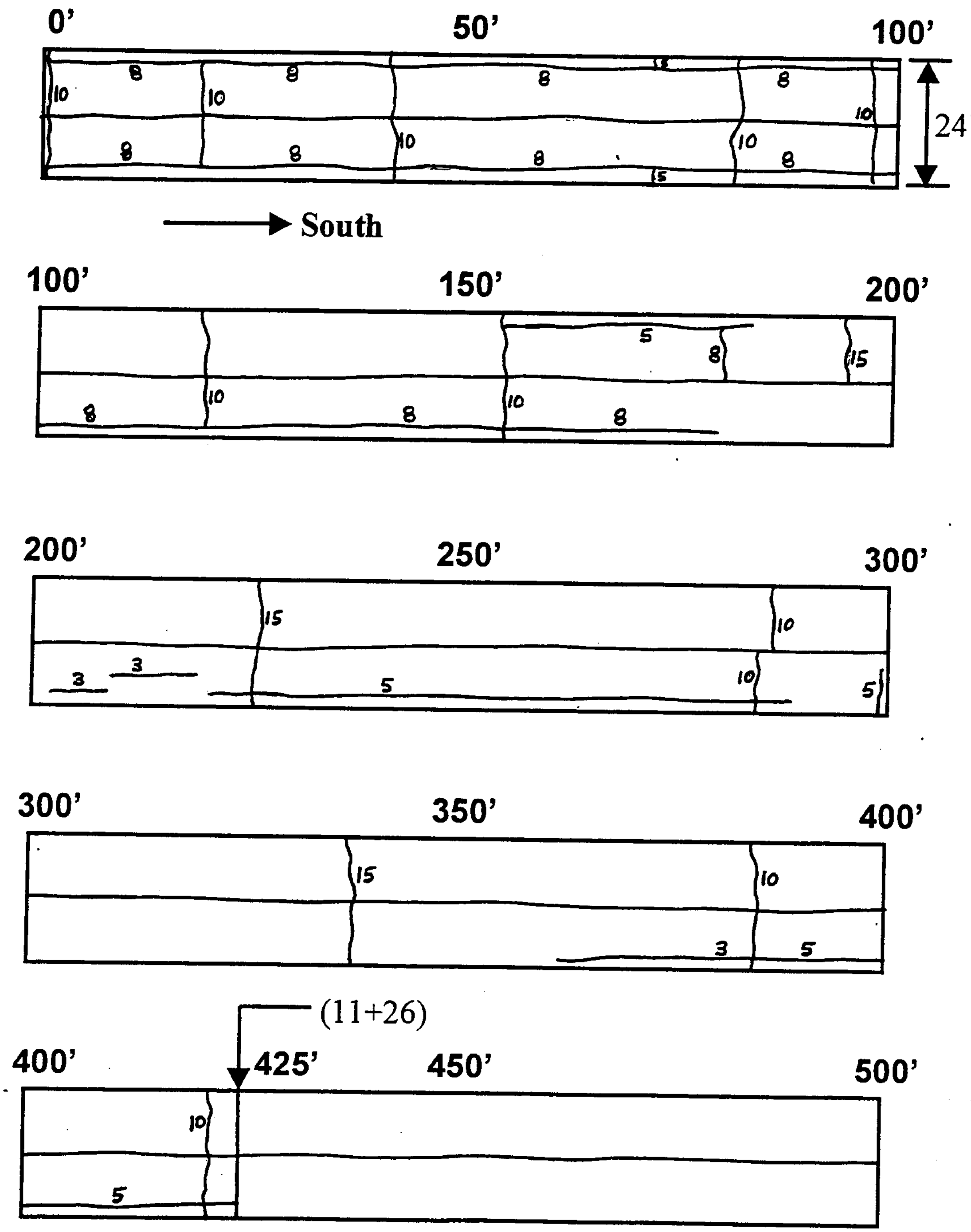

Figure D4. Crack Survey for IL 178

Location/Description:US 136 from US 67 to IL 41 (Strip Treated Section)

Date:6/23/98 **(Note: Crack widths indicated on survey are given in mm.)**

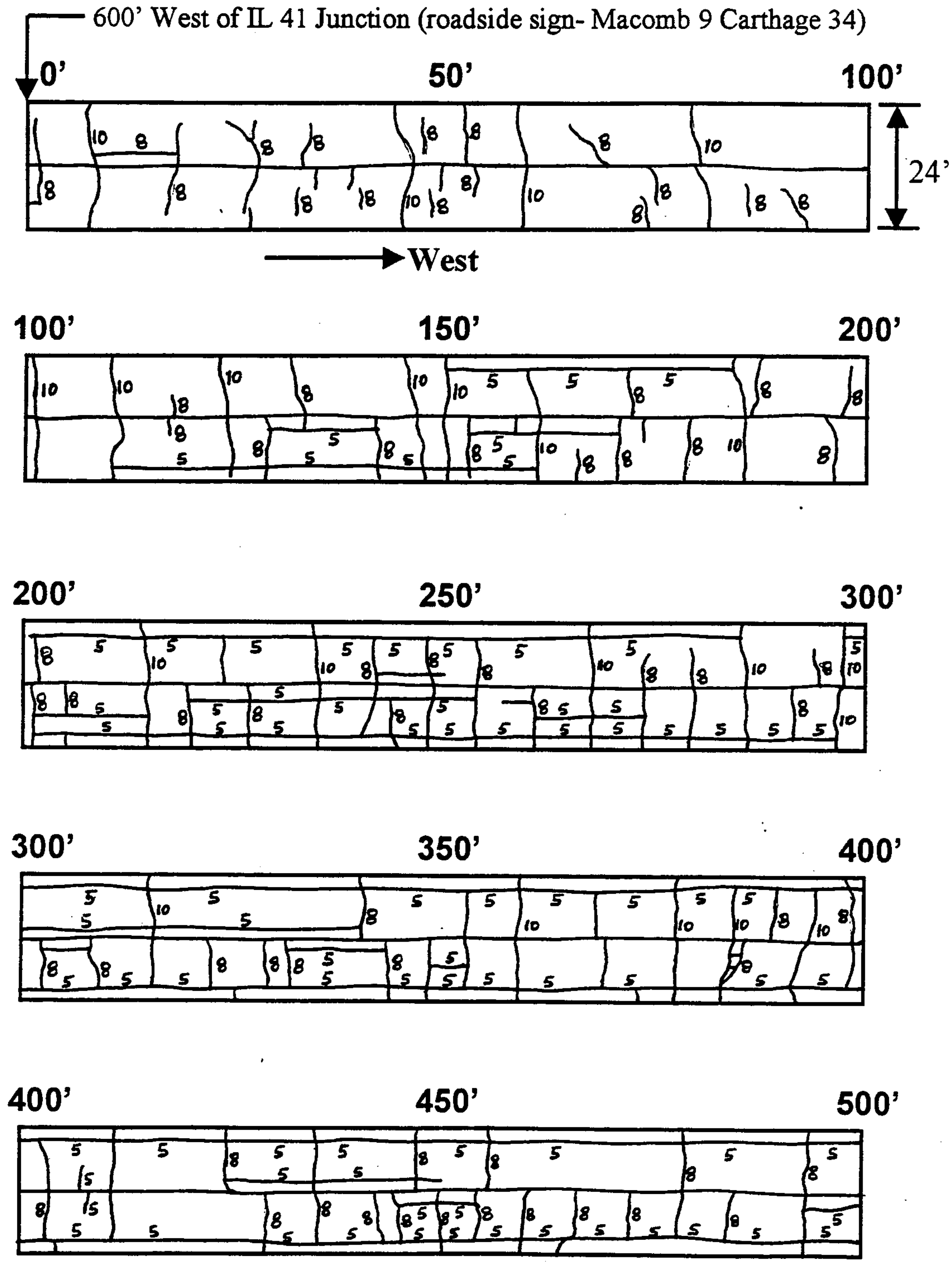

Figure D5. Crack Survey for US 136

Location/Description: US 136 from US 67 to IL 41 (Control Section)
Date: 6/23/98 **(Note: Crack widths indicated on survey are given in mm.)**

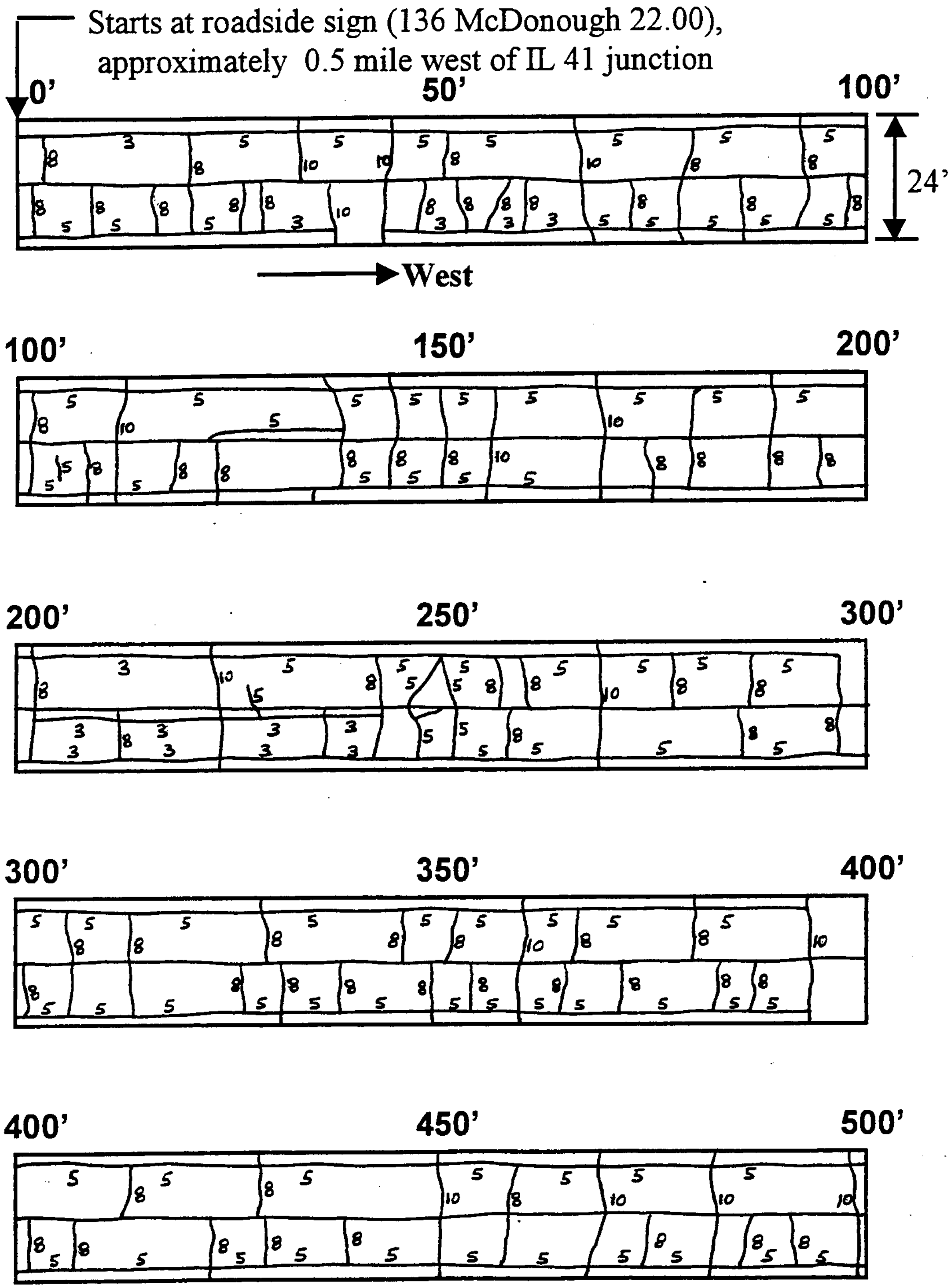

Figure D6. Crack Survey for US 136

Location/Description: <u>IL 9 1 to 2 miles east of IL 41, South of Prairie City (Area Treated Section)</u> **Date:** <u>6/22/98</u>

(Note: Crack widths indicated on survey are given in mm.)

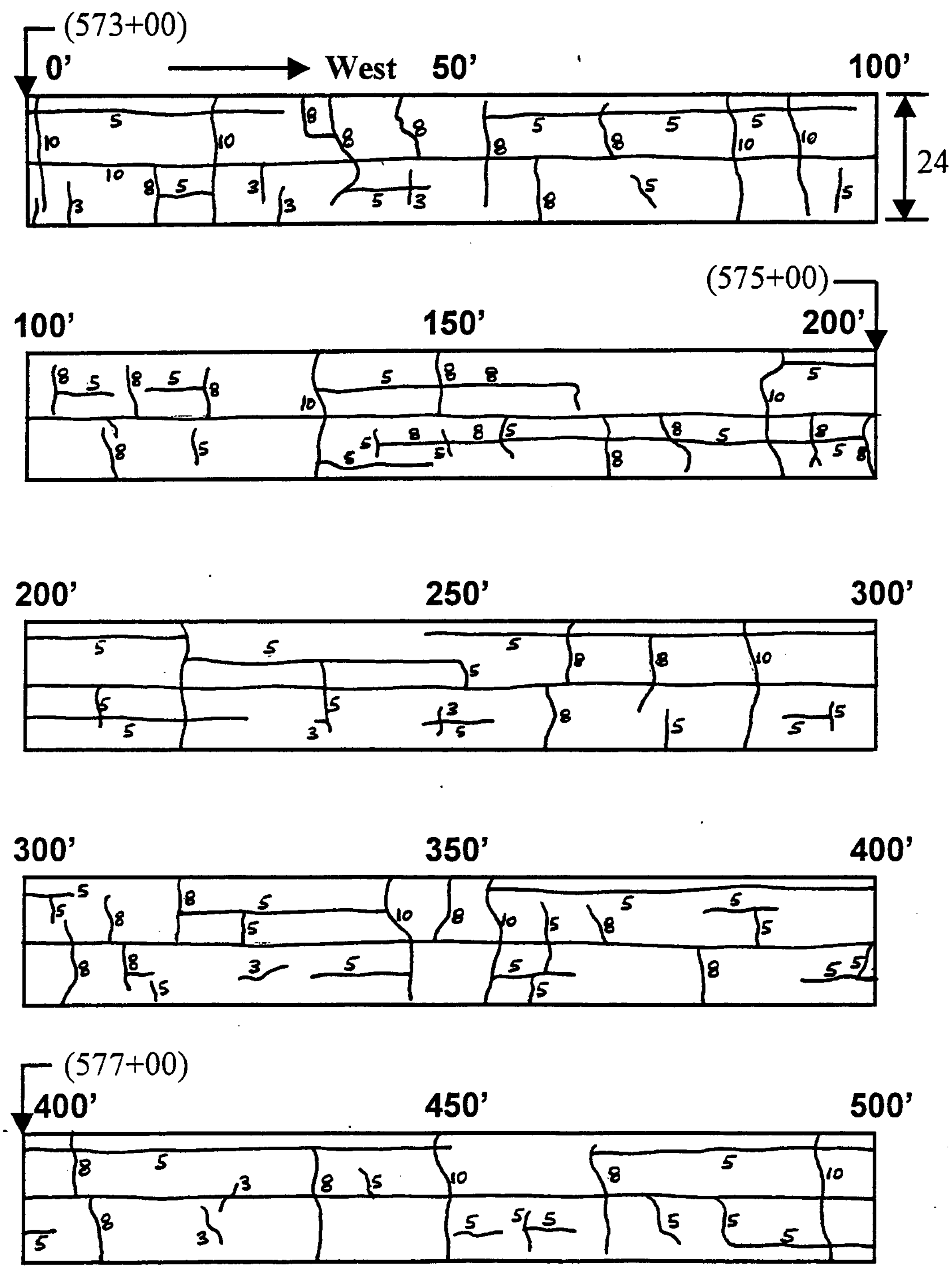

Figure D7. Crack Survey for IL 9

Location/Description: IL 9 1 to 2 miles east of IL 41, South of Prairie City (Control Section) Date:6/22/98

(Note: Crack widths indicated on survey are given in mm.)

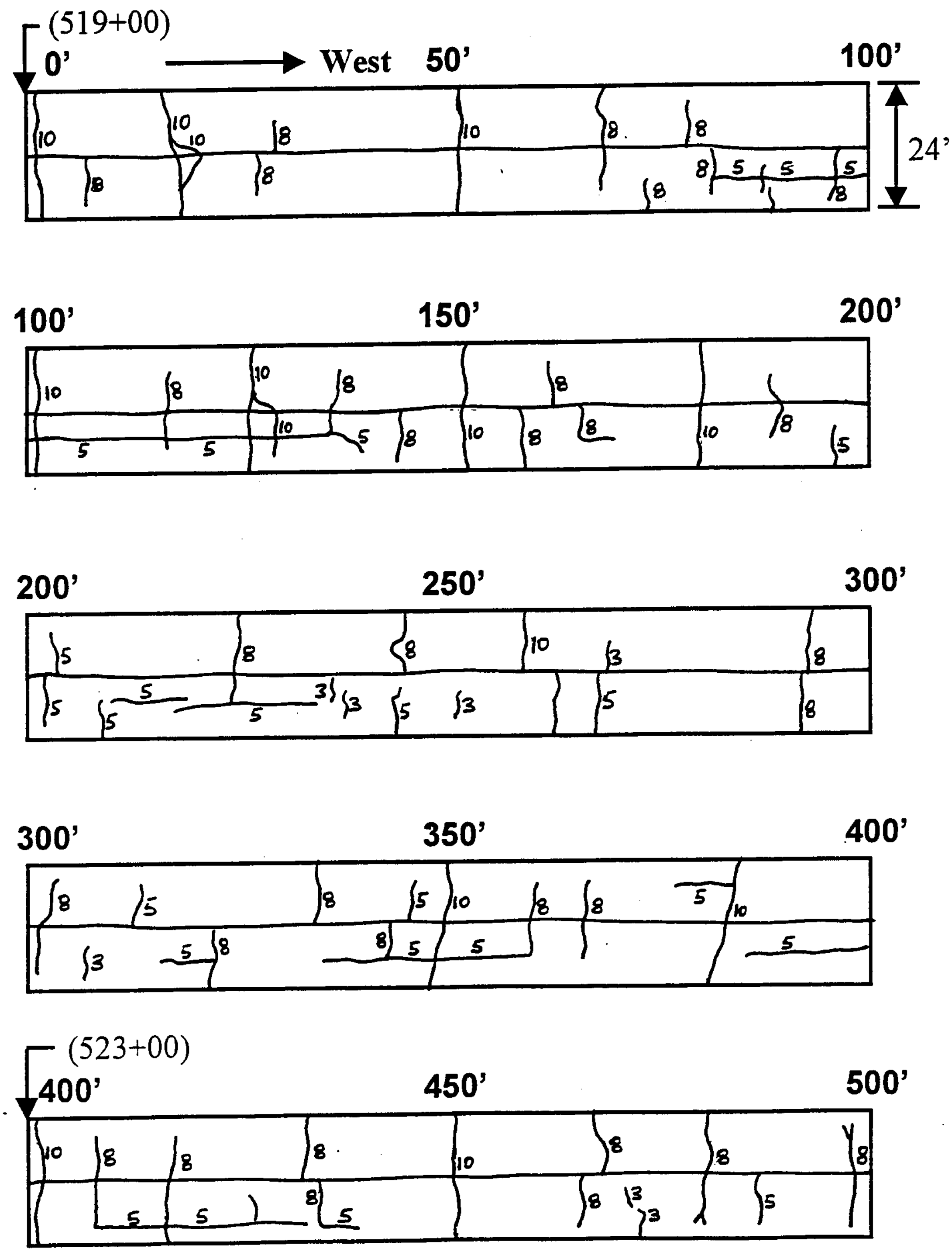

Figure D8. Crack Survey for IL 9

Location/Description:US 34 South of Gladstone to South of Kirkwood (Strip Treated Section) Date:6/22/98

(Note: Crack widths indicated on survey are given in mm.)

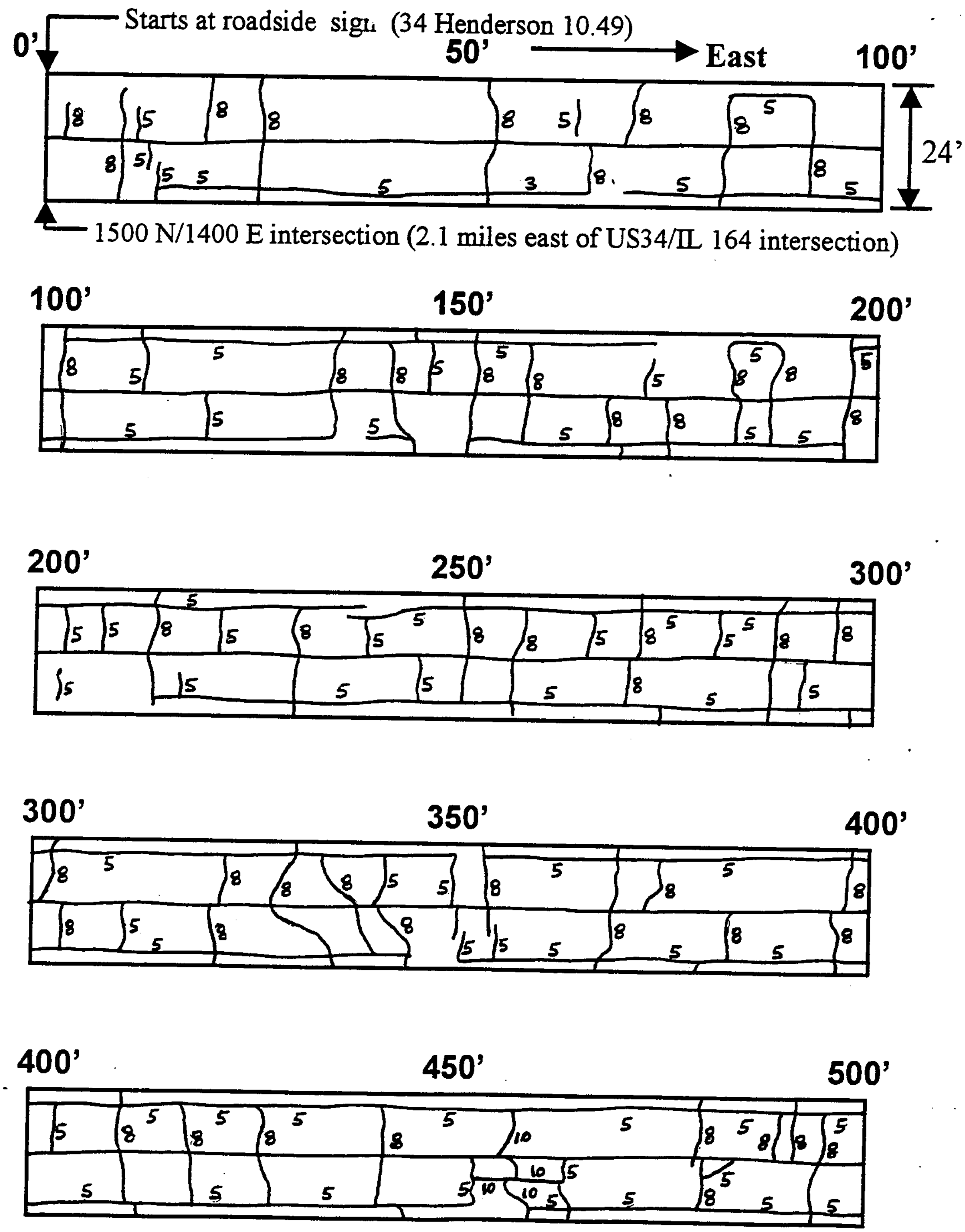

Figure D9. Crack Survey for US 34

Location/Description: US 34 South of Gladstone to South of Kirkwood (Control Section) - 24' wide existing PCC (widening joints right below white striping) Date: 6/22/98

(Note: Crack widths indicated on survey are given in mm.)

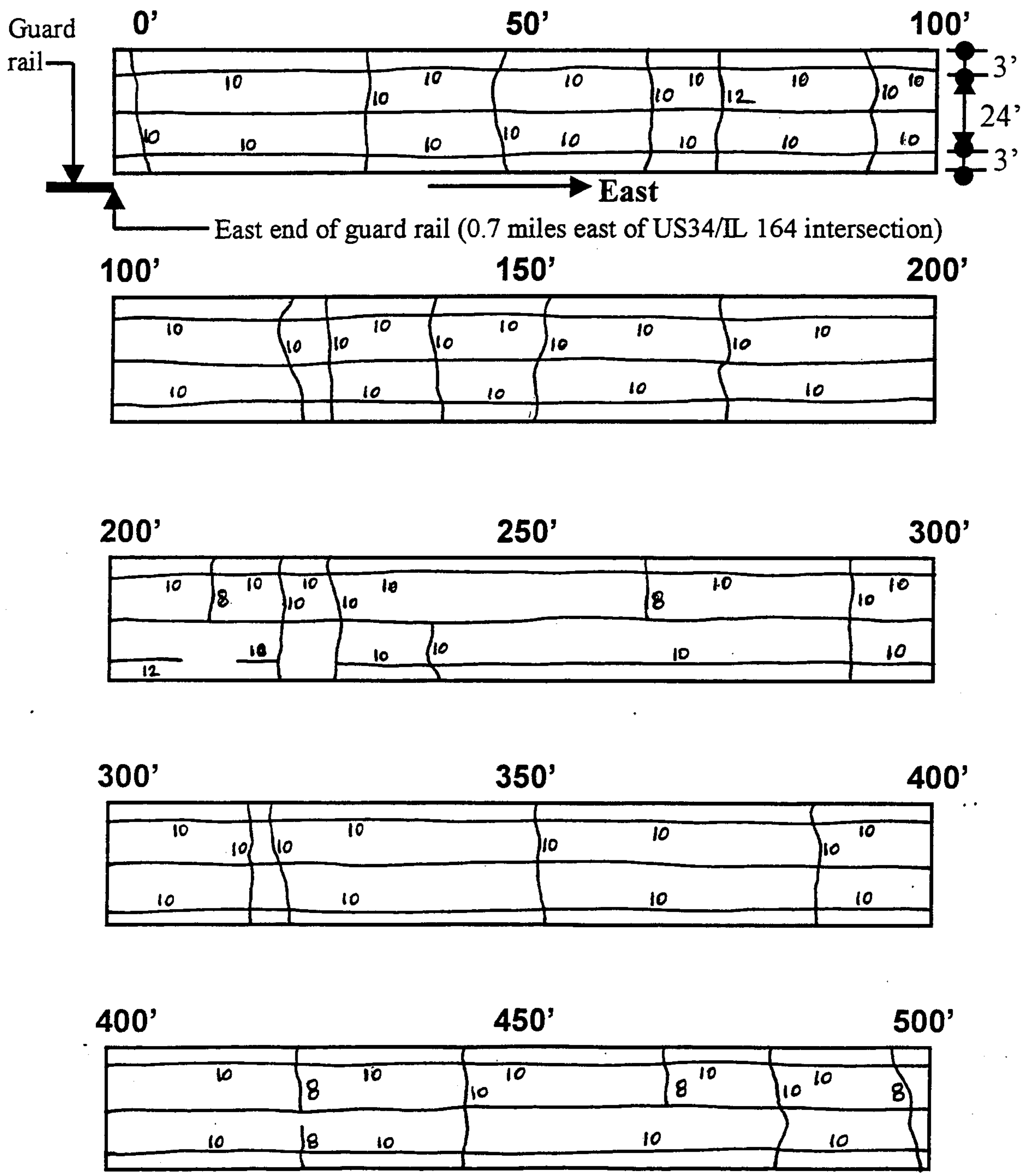

Figure D10. Crack Survey for US 34

Location/Description: IL 130 Philo to Villa Grove (Strip Treated Section) **Date:** 6/19/98 **(Note: Crack widths indicated on survey are given in mm.)**

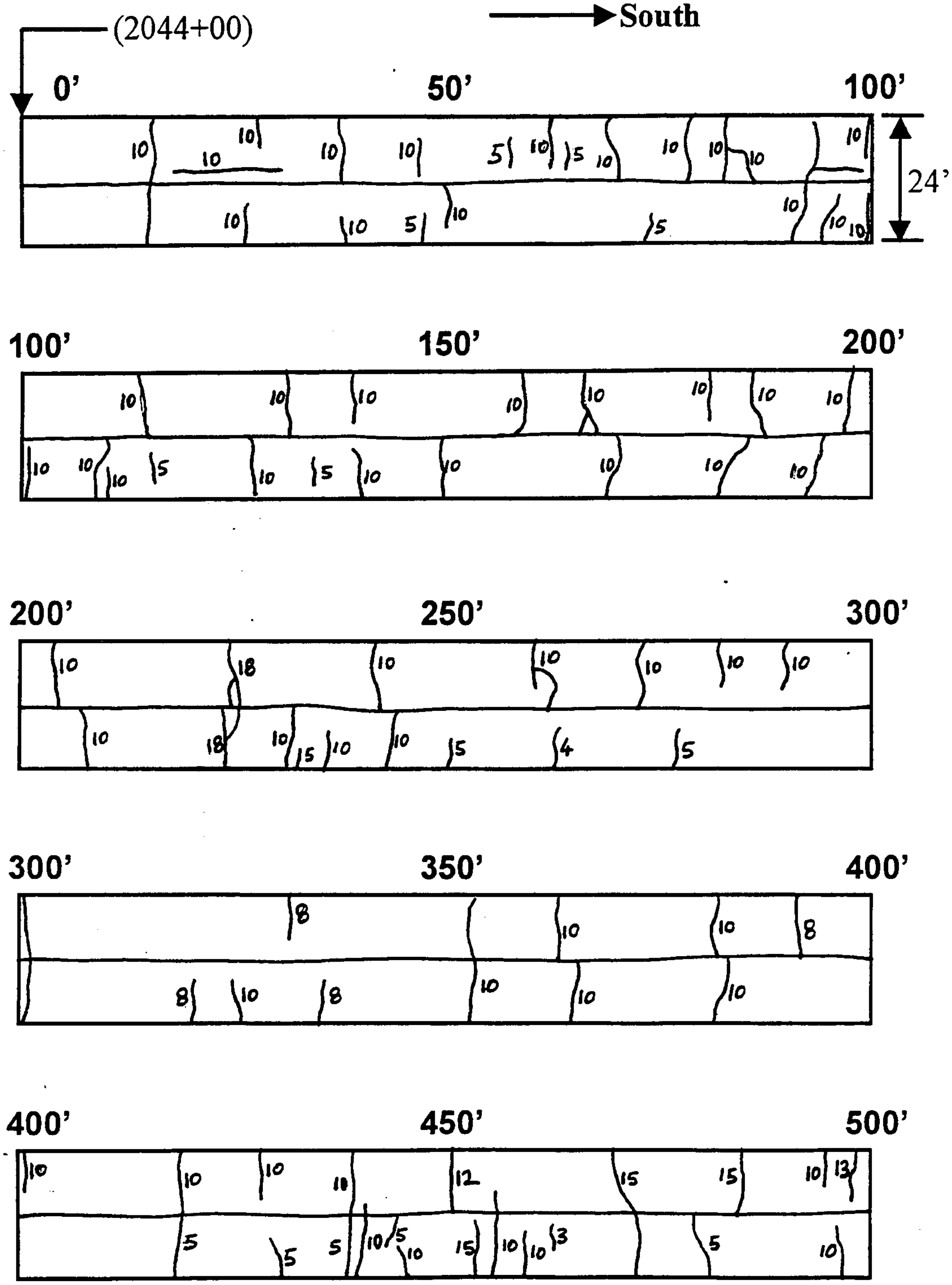

Figure D11. Crack Survey for IL 130

Location/Description: <u>IL 130 Villa Grove to Camargo (Control Section)</u> **Date:** <u>6/19/98</u> **(Note: Crack widths indicated on survey are given in mm.)**

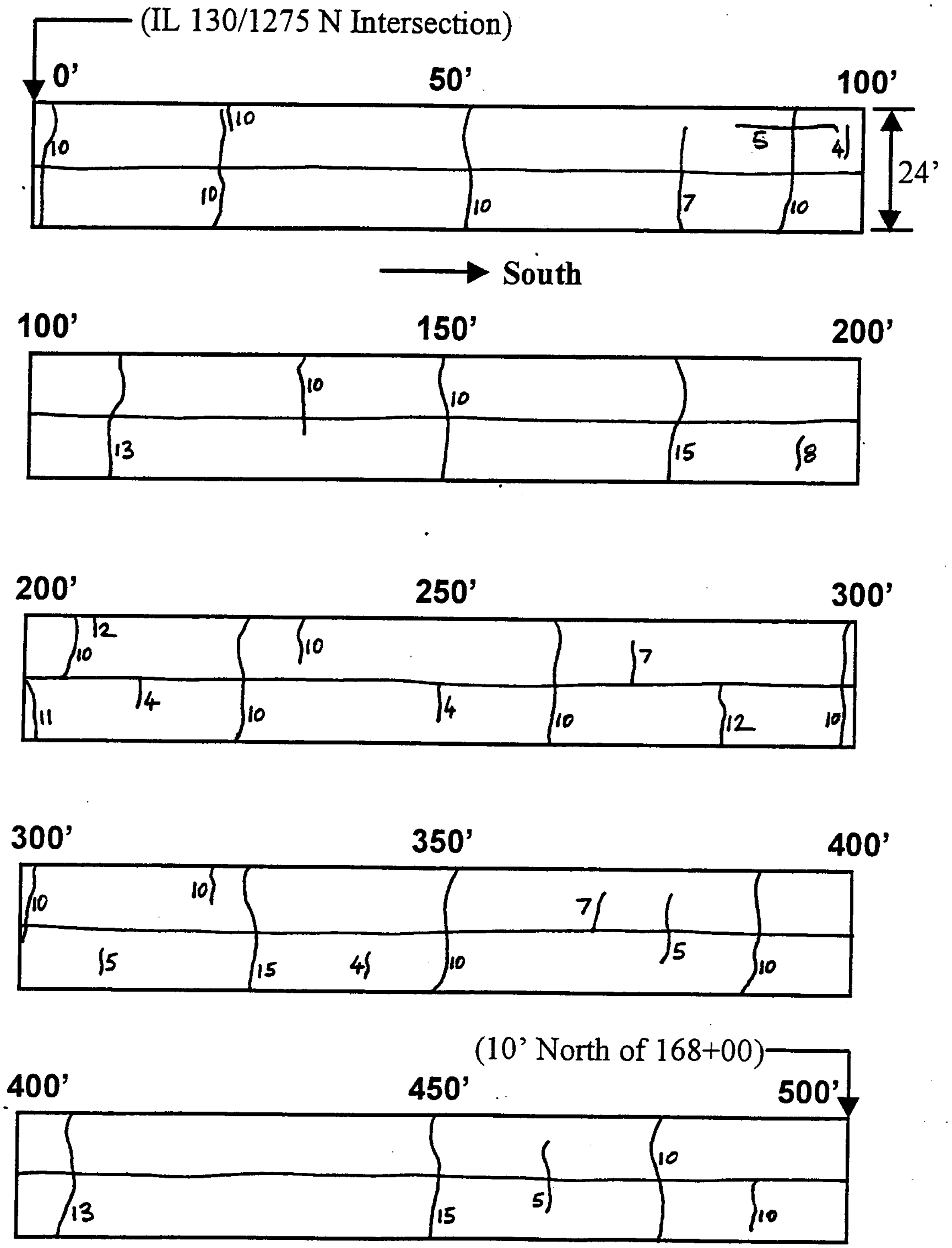

Figure D12. Crack Survey for IL 130

Location/Description:US 66 from IL 10 intersection to Salt Creek (Area Treated Section) - North Bound Date:6/23/98

(Note: Crack widths indicated on survey are given in mm.)

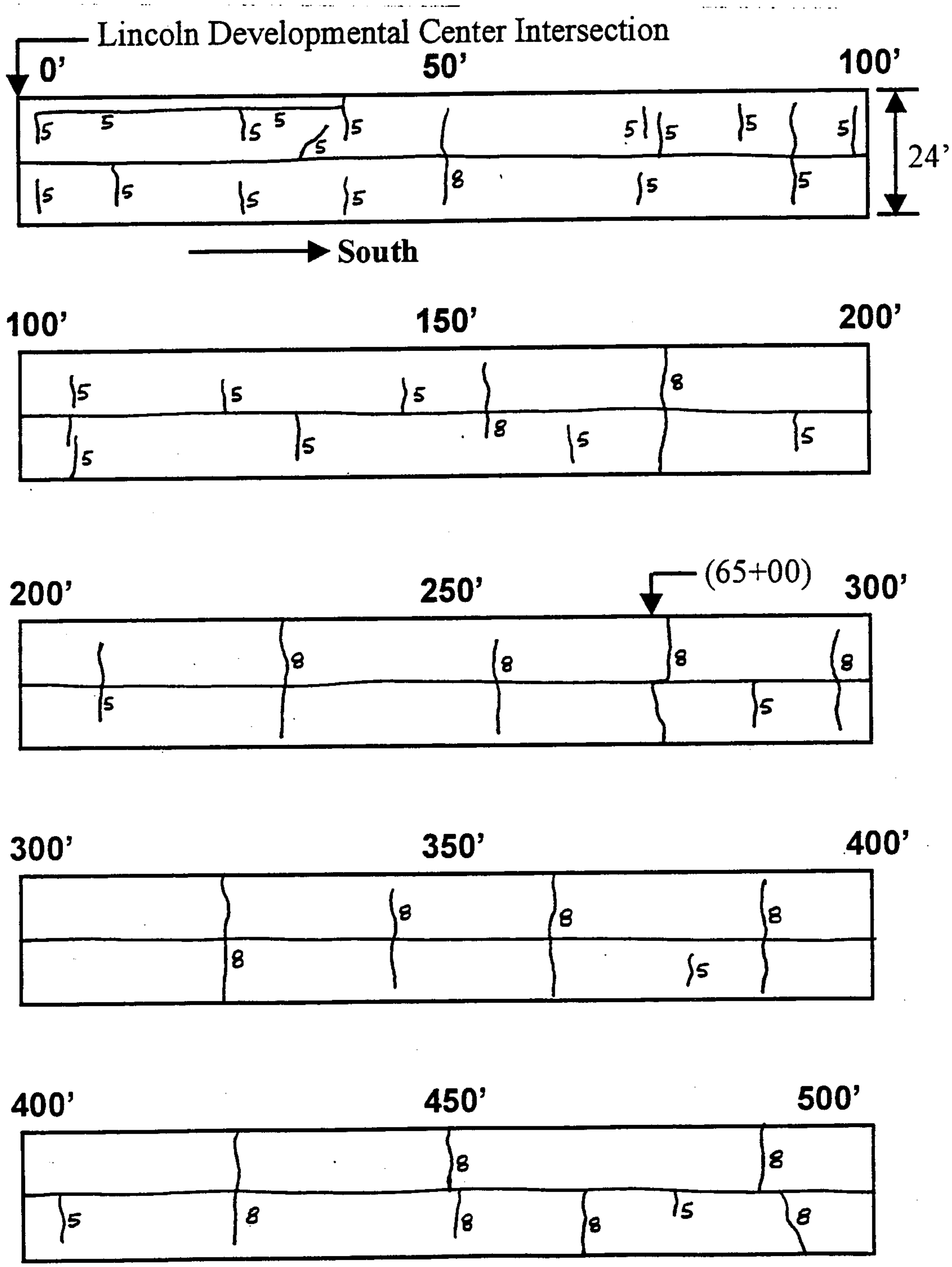

Figure D13. Crack Survey for US 66 – North Bound

Location/Description:__US 66 from IL 10 intersection to Salt Creek (Area Treated Section) - South Bound__ **Date:**__6/23/98__

(Note: Crack widths indicated on survey are given in mm.)

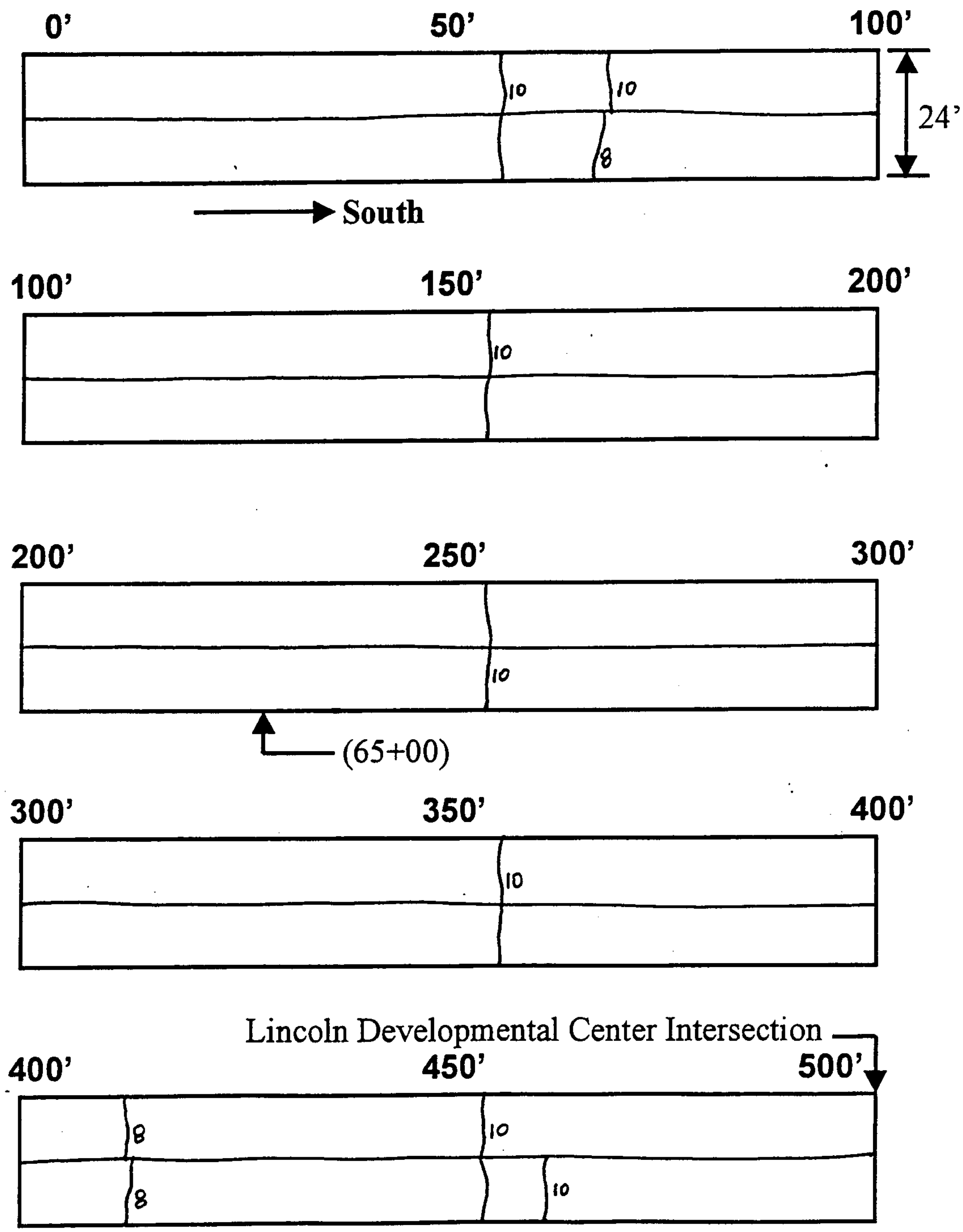

Figure D14. Crack Survey for US 66 – South Bound

Location/Description:US 66 from IL 10 intersection to Salt Creek (Control Section) - North Bound Date:6/23/98

(Note: Crack widths indicated on survey are given in mm.)

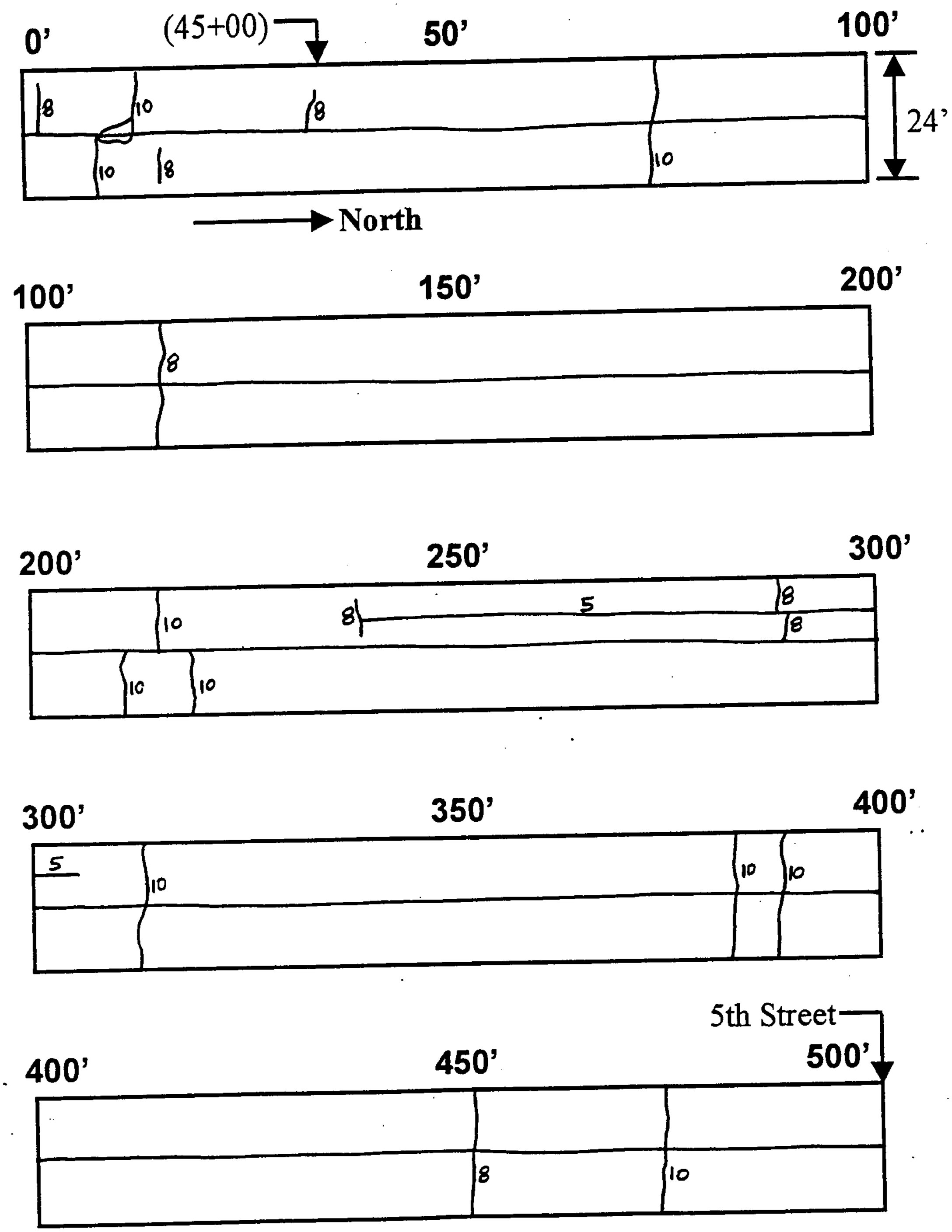

Figure D15. Crack Survey for US 66 – North Bound

Location/Description: US 66 from IL 10 intersection to Salt Creek (Control Section) - South Bound Date: 6/23/98

(Note: Crack widths indicated on survey are given in mm.)

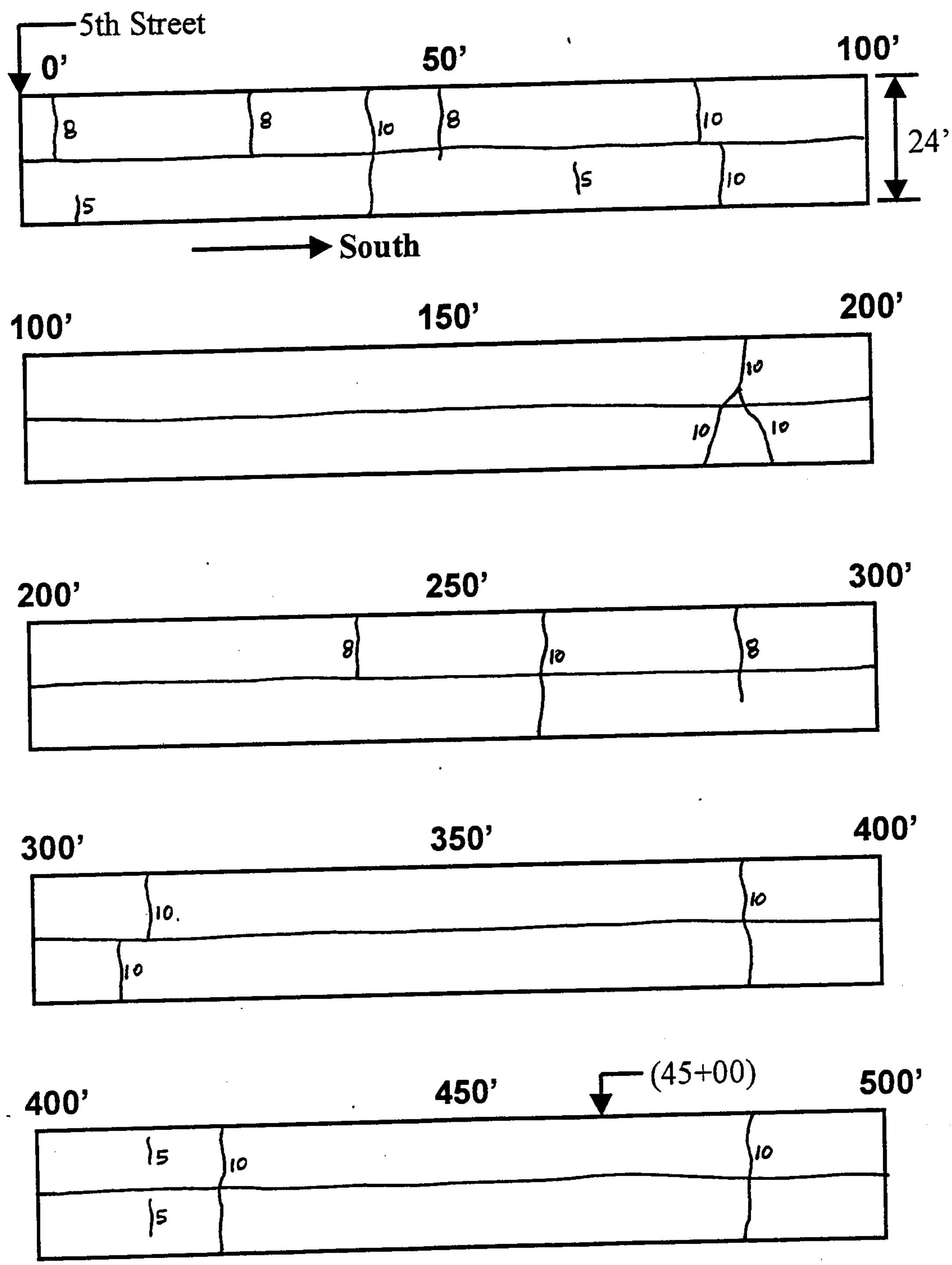

Figure D16. Crack Survey for US 66 – South Bound

Location/Description: IL 4/13 from Marissa to Tilden

(Control Section) Date:6/24/98

(Note: Crack widths indicated on survey are given in mm.)

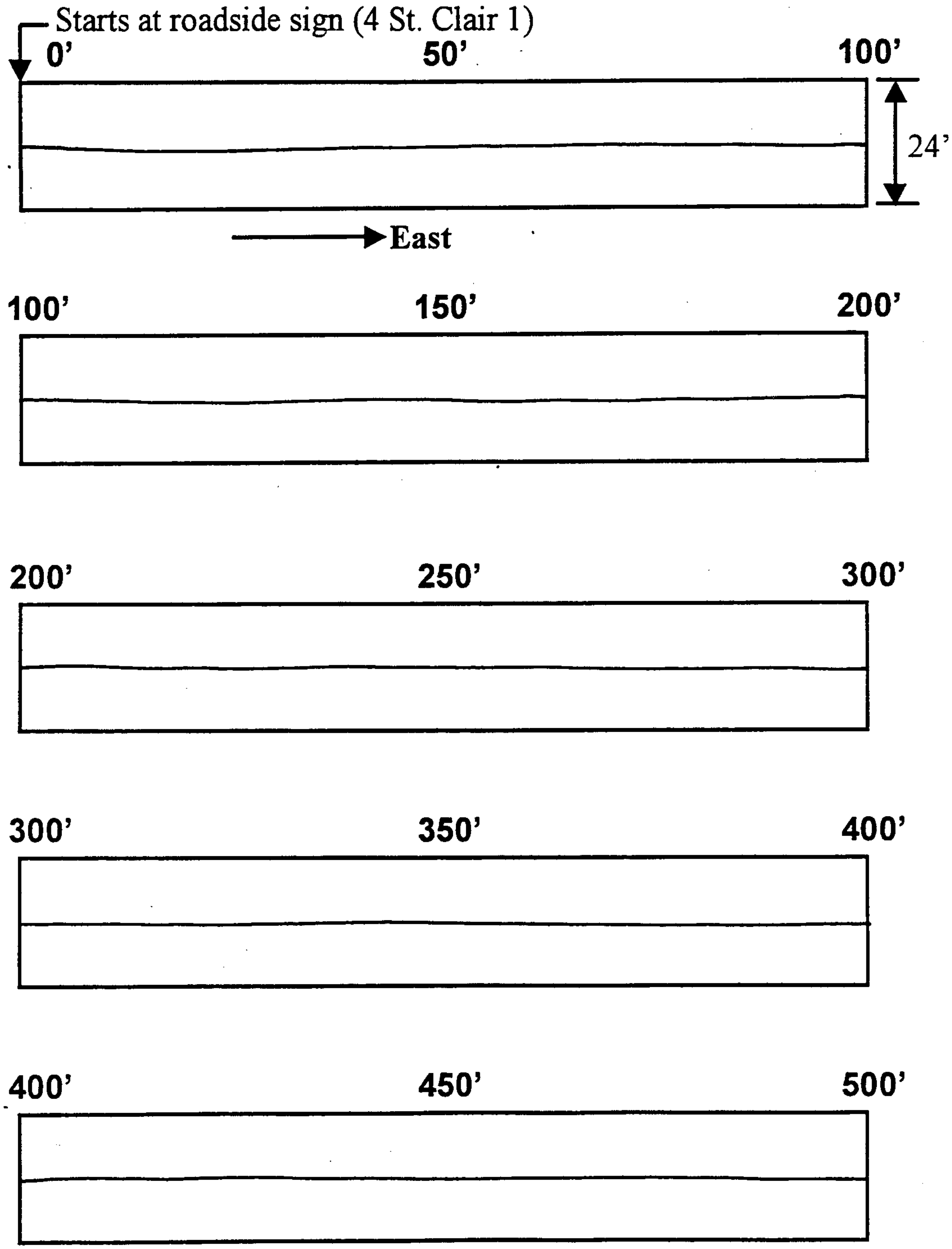

Figure D17. Crack Survey for IL 4/13

Location/Description: IL 111 in Pontoon Beach (Area Treated Section) - South Bound Date: 6/24/98

(Note: Crack widths indicated on survey are given in mm.)

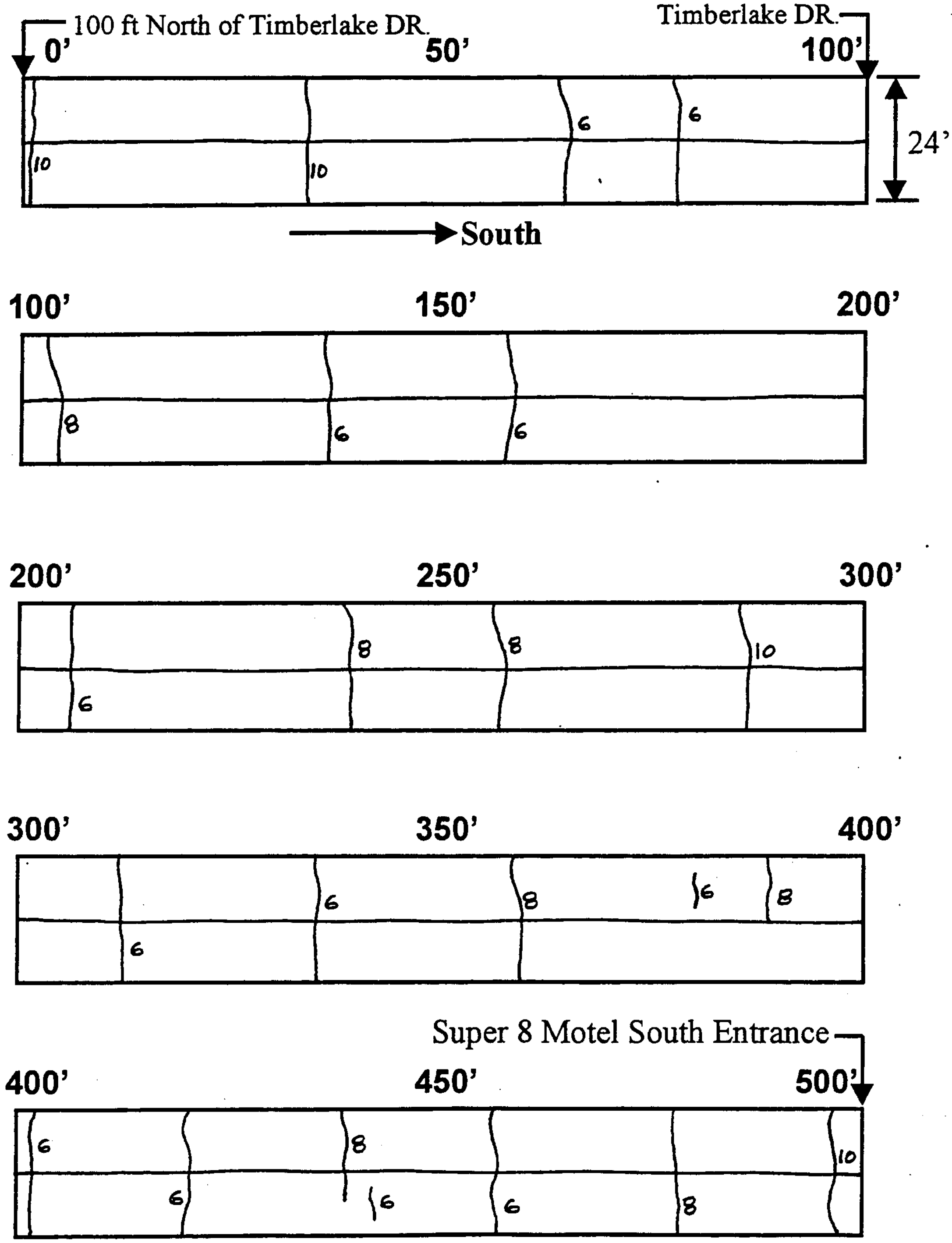

Figure D18. Crack Survey for IL 111 – South Bound

Location/Description:IL 111 in Pontoon Beach (Control Section) - South Bound Date:6/24/98

(Note: Crack widths indicated on survey are given in mm.)

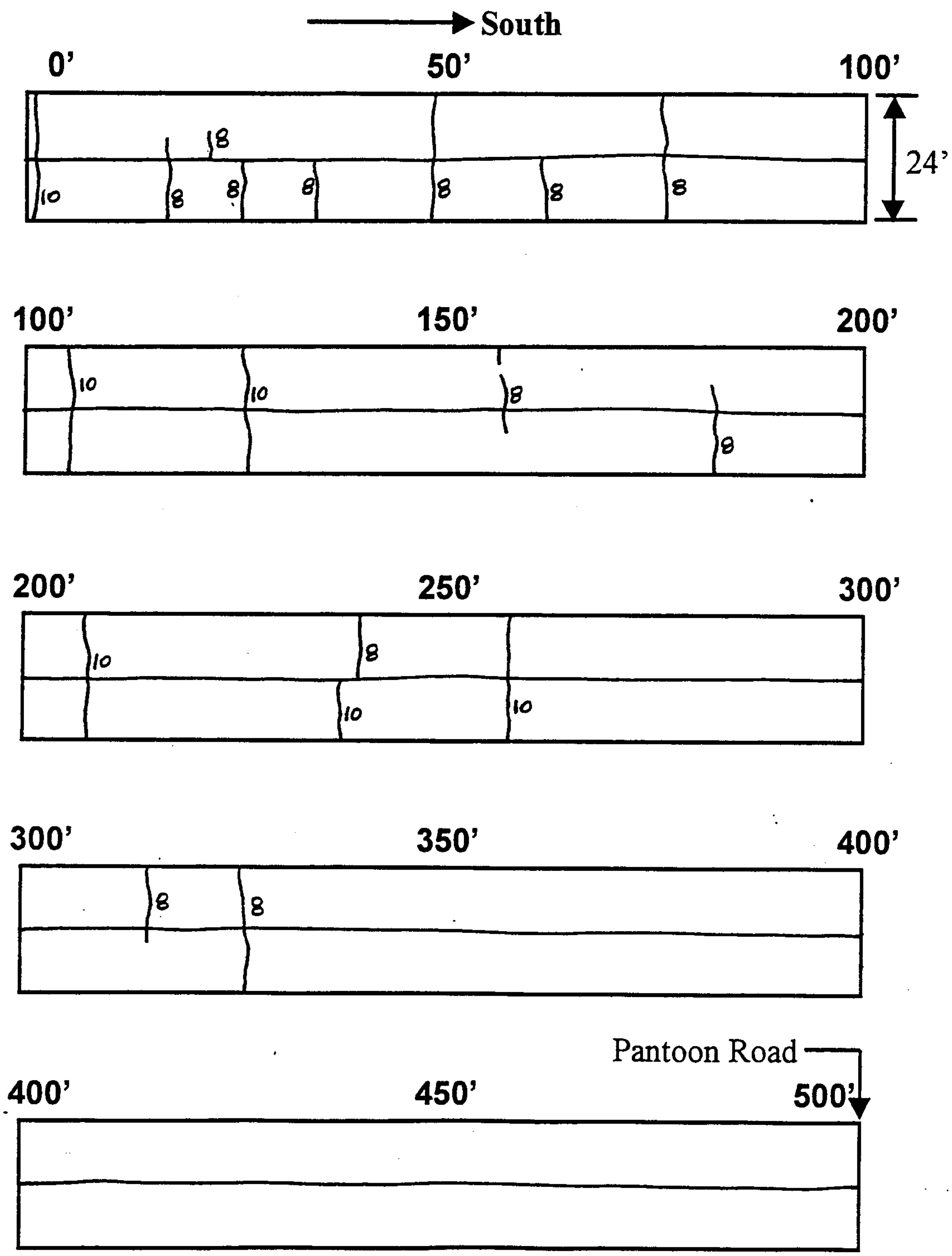

Figure D19. Crack Survey for IL 111 – South Bound

Location/Description: IL 111 in Pontoon Beach (Control Section) - South Bound Date: 6/24/98

(Note: Crack widths indicated on survey are given in mm.)

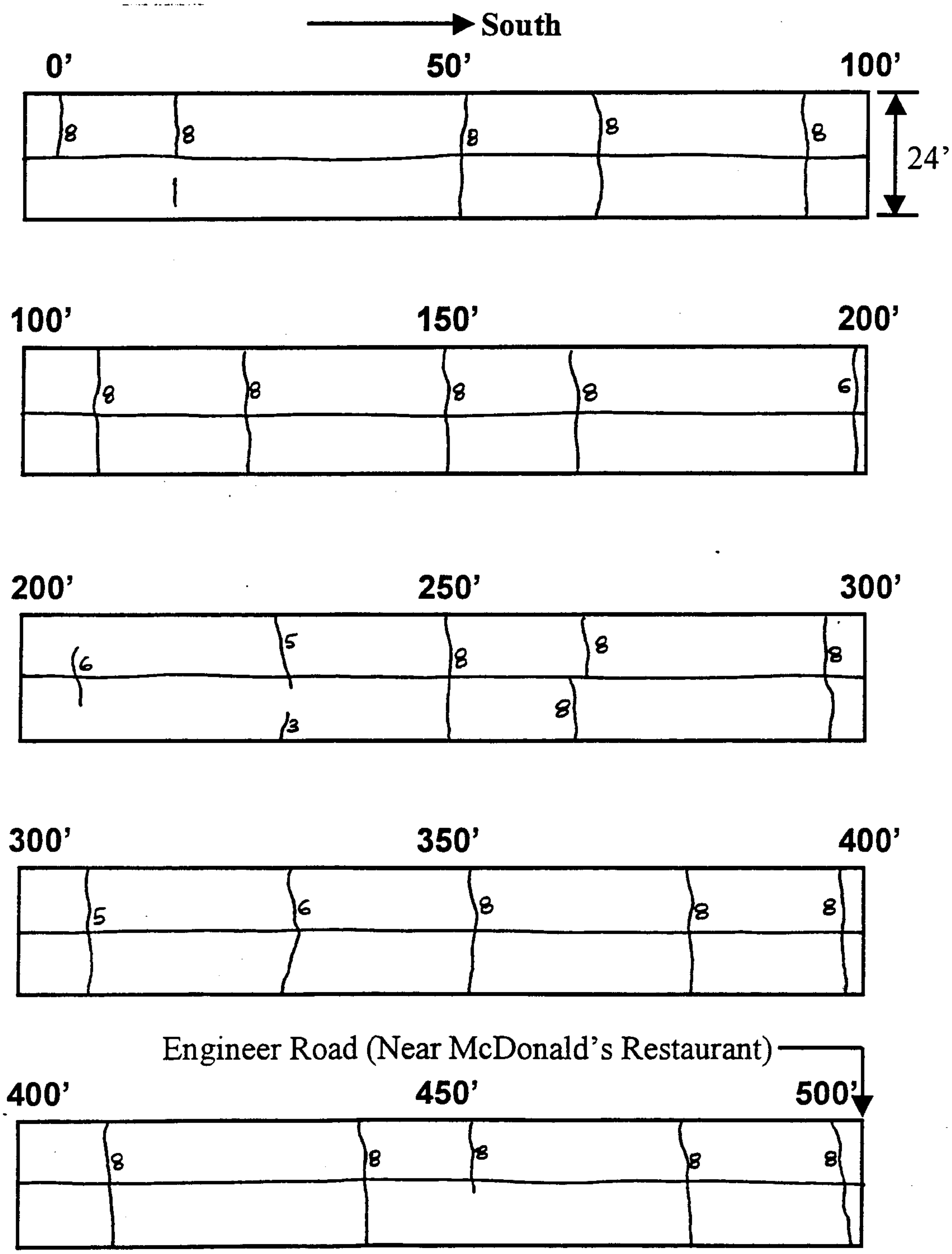

Figure D20. Crack Survey for IL 111 – South Bound

Location/Description:______________________________

Date:______________ (Note:Crack widths indicated on survey are given in mm.)

0'	50'	100'

100'	150'	200'

200'	250'	300'

300'	350'	400'

400'	450'	500'

Appendix E

(Performance Curves)

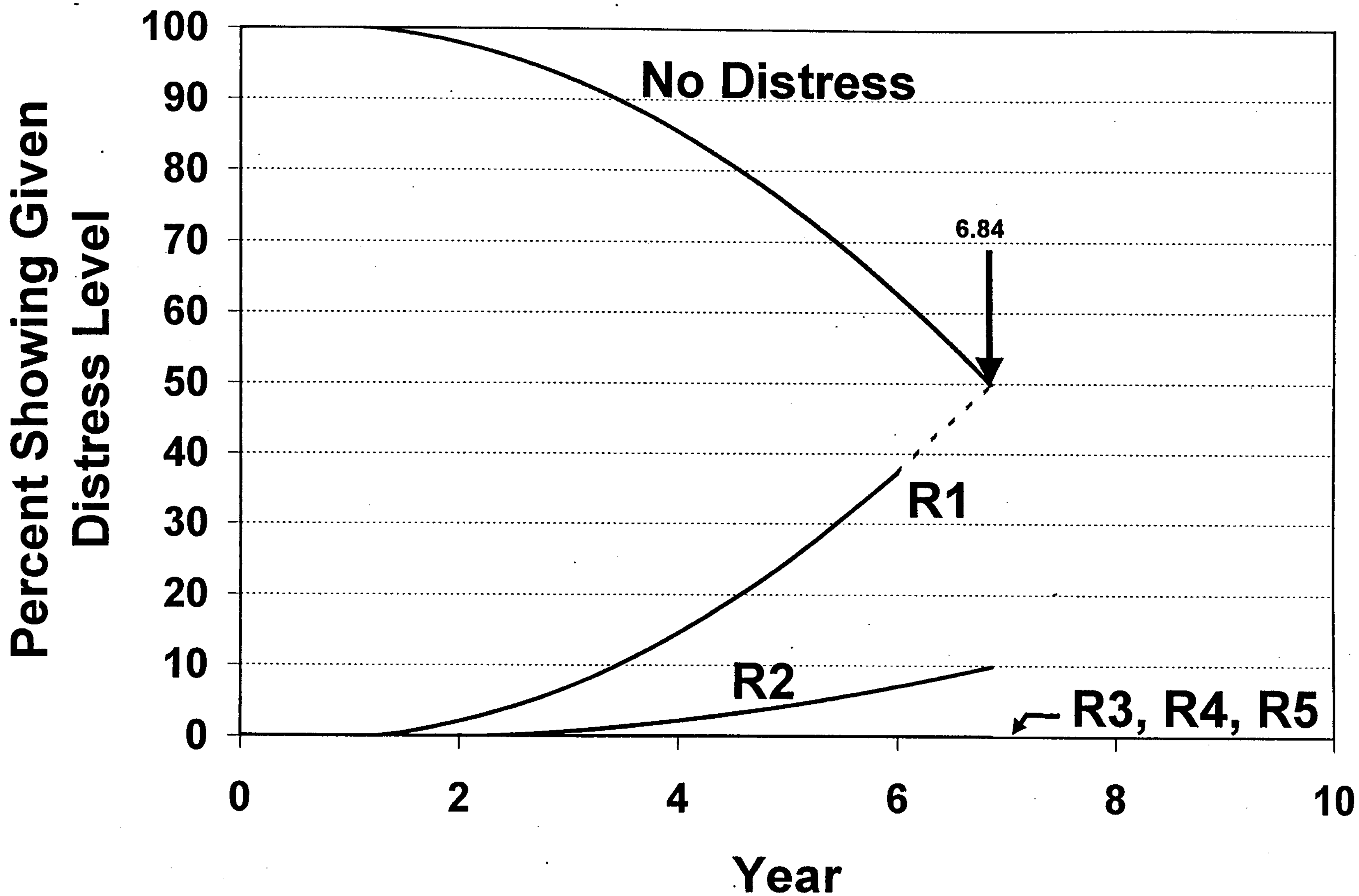

Figure E1. Performance Curve for Reflective Widening Crack, All Projects with Strip Treatment

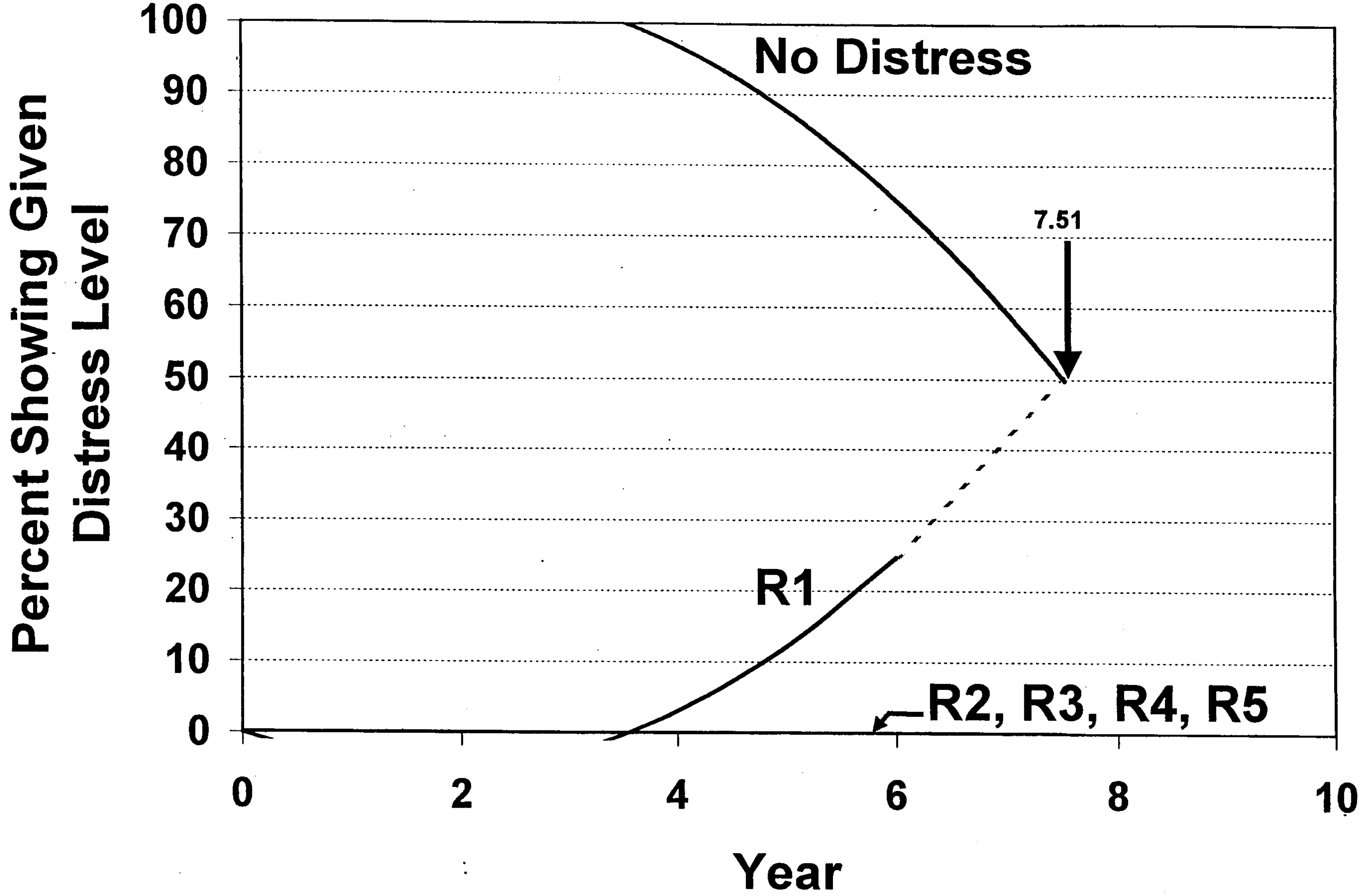

Figure E2. Performance Curve for Reflective Widening Crack, All Projects with Area Treatment

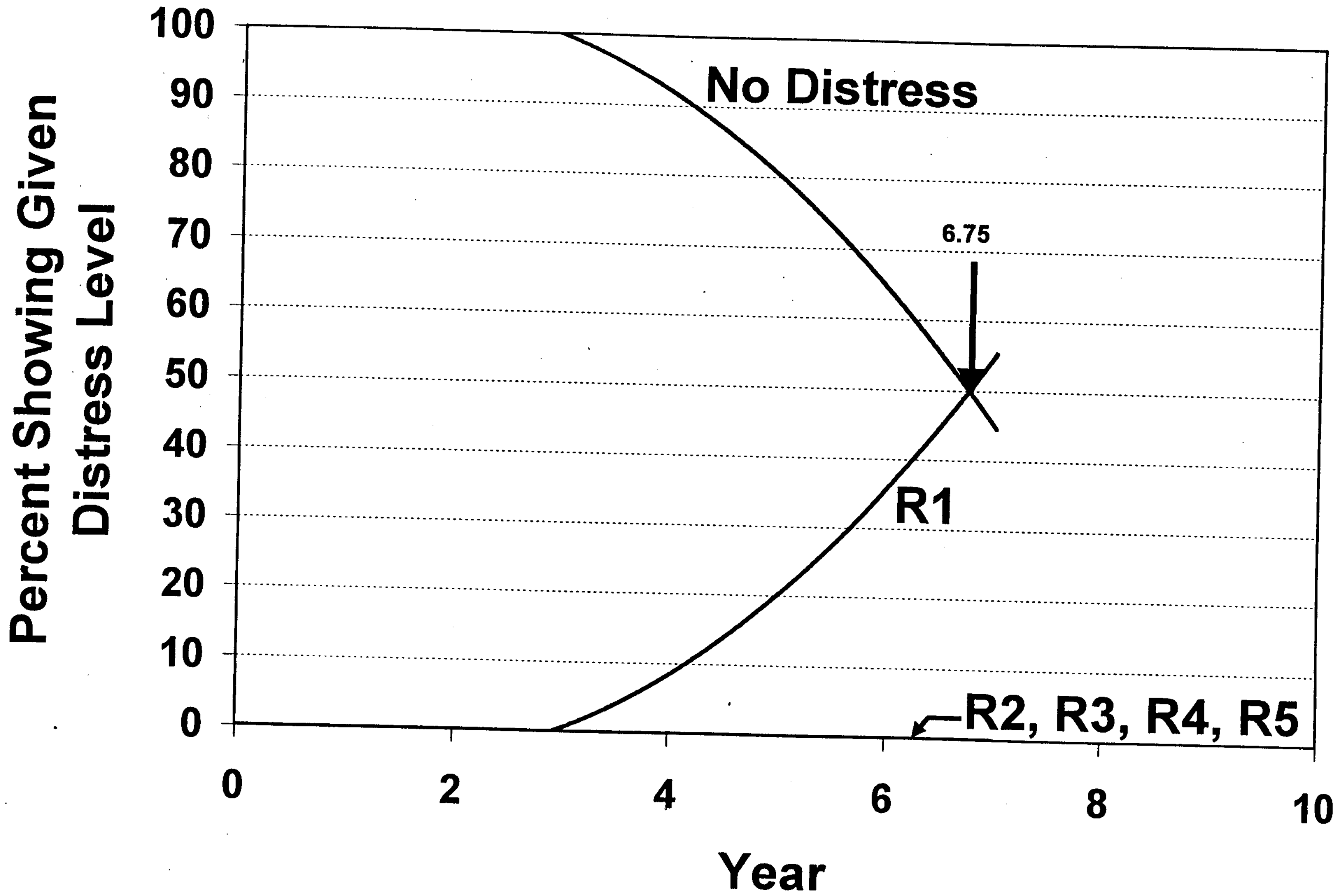

Figure E3. Performance Curve for Reflective Widening Crack, All Control Sections

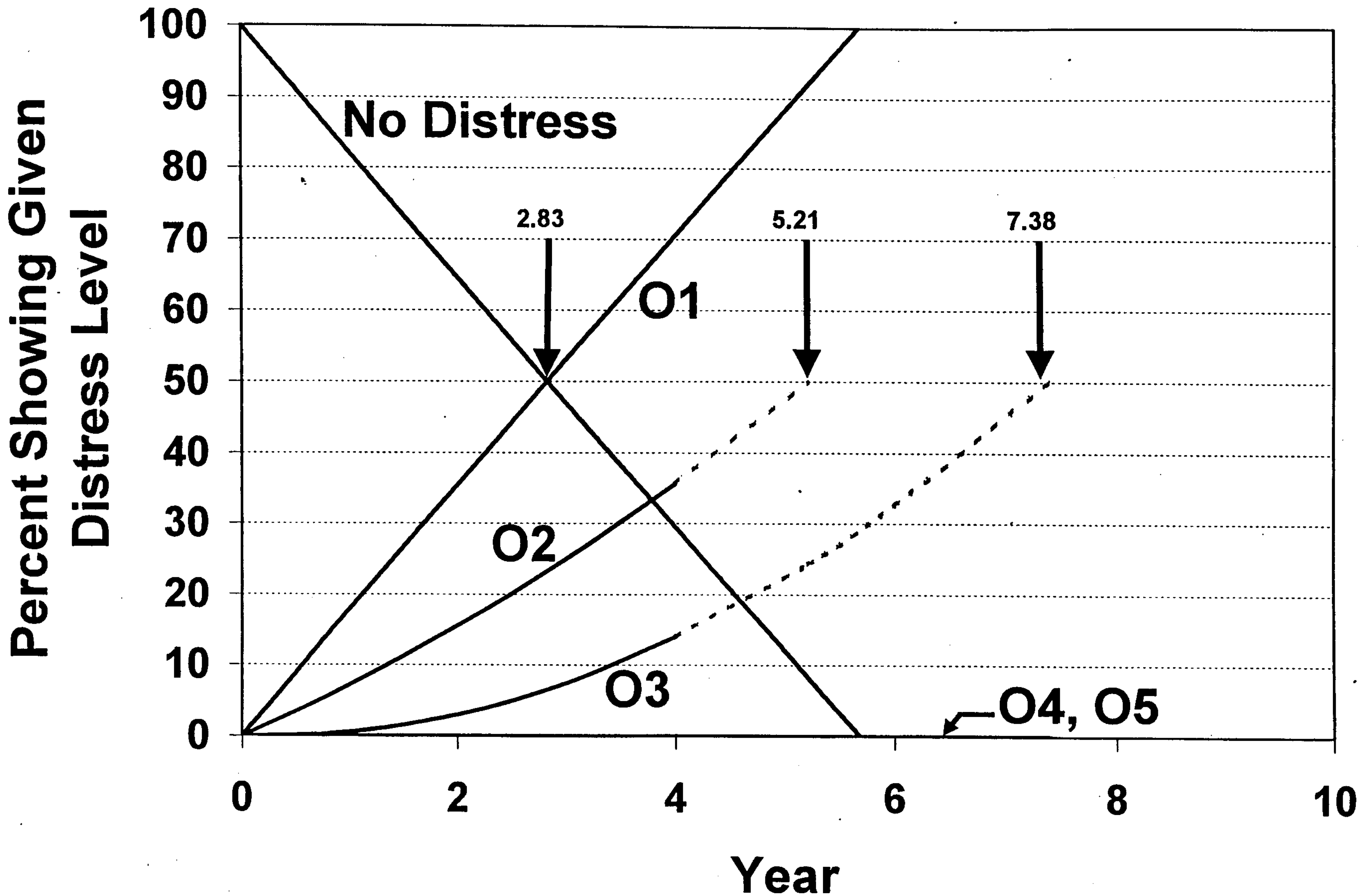

Figure E4. Performance Curve for Transverse Cracking/Joint Reflection Cracks, All Projects with Area Treatment

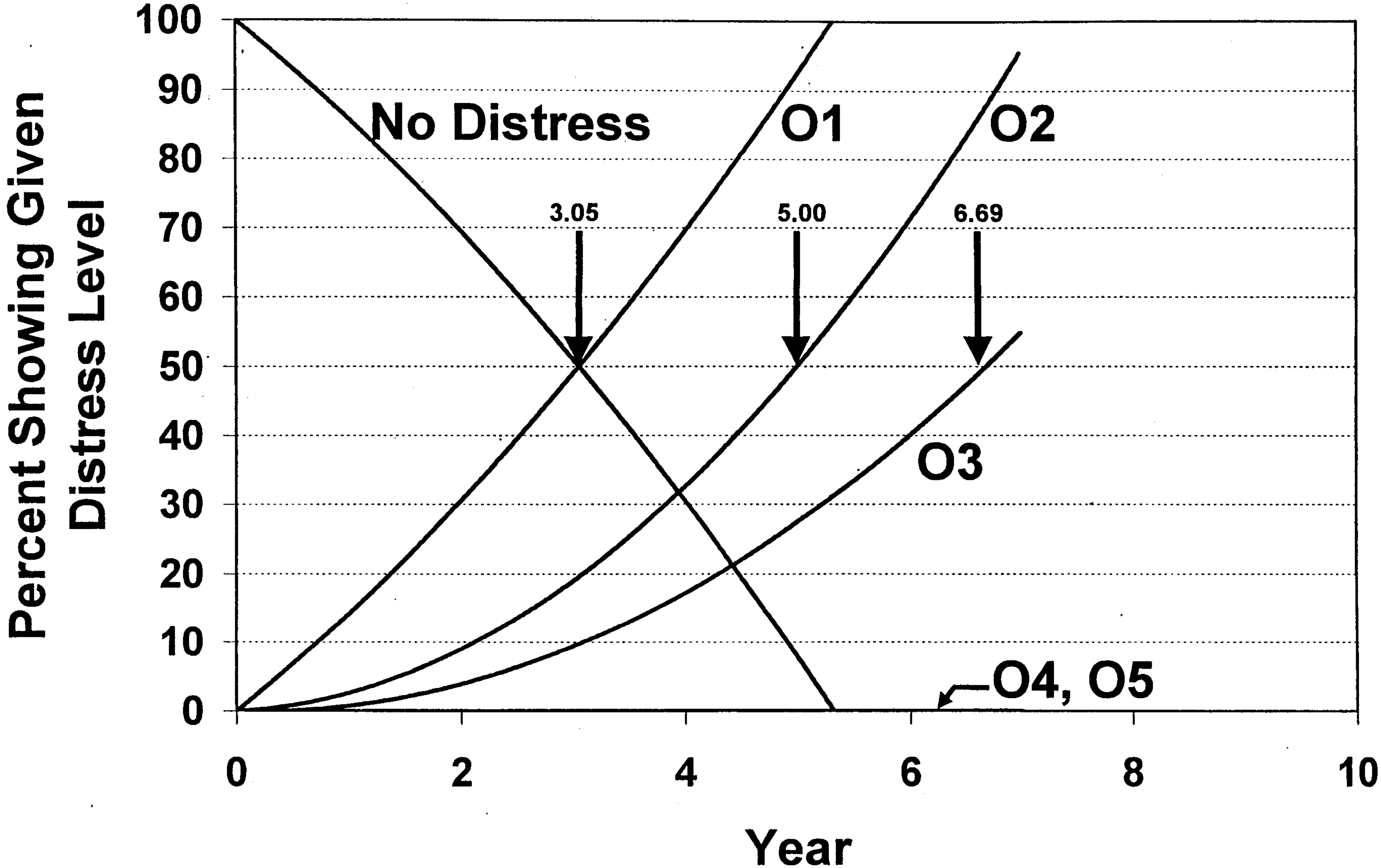

Figure E5. Performance Curve for Transverse Cracking/Joint Reflection Cracks, All Control Sections and Strip Treatments Lumped Together

Appendix F

(Documentation on New Experimental Sections)

Experimental Sections Documentation
Reflective Crack Control Project

I 474 – Area Treatment

Location/Project Information:

Route/ Contract/ Project completion date: I 474/Contract 88535/September, 1997

District/ County/ Nearby towns: District 4, Tazewell, East Peoria

Direction/Lanes included in Experimental Section: Eastbound, Passing Lane

Stationing limits for Experimental Section(s): 18 + 000 to 18 + 600

Experimental Section Layout Information:

Existing pavement type and condition: 8 in. (203 mm) CRCP, extensive D-Cracking, no previous overlays

Description of any milling, patching, crack sealing, and other rehabilitation activities prior to placement of paving fabric and overlay lifts: Full depth, intermittent concrete patching w/ steel reinforcing bar replacement.

Treated Section(s):

Station limits: 18 + 000 to 18 + 300

Lane(s)/ direction: Passing lane, Eastbound

Untreated Section(s):

Station limits: 18 + 300 to 18 + 600

Lane(s)/ direction: Passing lane, Eastbound

Overlay and Crack Control Information:

Total overlay thickness: 5.1 in. (130 mm), including two, 1.77-in. (45-mm) binder lifts and a 1.57-in. (40-mm) surface course. Fabric placed over first binder lift.

Average thickness of leveling binder: 1.77 in. (45 mm), as described above

Asphalt mixture type(s): Surface = Mix D, Class I, Type 1; Binder = Mix B, Type 1

Asphalt binder grade: AC-20 used in overlay courses

Fabric system: Amoco Petromat, 4 oz/yd^2, non-woven polypropylene, System A, Area Treatment

Experimental Sections Documentation
Reflective Crack Control Project

IL 29/US 24 Area Treatment

Location/Project Information:

Route/ Contract/ Project completion date: IL 29/ US 24 / Contract 88749/ October, 1997

District/ County/ Nearby towns: District 4/ Peoria County/ Downtown Peoria, Jefferson St.

Direction/Lanes included in Experimental Section: One-way street, southbound, all 3 lanes

Stationing limits for Project: 33 + 352 to 35 + 910

Landmarks (if applicable): Fabric omission between Abington St. and railroad tracks

Experimental Section Layout Information:

Existing pavement type and condition: Brick, overlayed with bituminous parabolic crown

Description of any milling, patching, crack sealing, and other rehabilitation activities prior to placement of paving fabric and overlay lifts: Variable depth rotomilling to provide crown and patching. Fabric placed on milled surface.

Treated Section(s):

Station limits: 35 + 475 to 35 + 225, Southbound, center and west lane, plus all 3 lanes between stations 33 + 352 to 35 + 225, and 35 + 475 to 35 + 910

Untreated Section(s):

Station limits: 35 + 475 to 35 + 225

Lane(s)/ direction: Southbound, east-most lane

Overlay and Crack Control Information:

Total overlay thickness: 1.5 in.

Average thickness of leveling binder: No level binder used. Fabric placed on milled surface.

Asphalt mixture type(s): D-Mix, Type II, AC-10, with RAP

Asphalt binder grade:

Fabric system: System A, Amoco Petromat, 4 oz/yd^2, non-woven polypropylene, Area treatment

Experimental Sections Documentation
Reflective Crack Control Project

IL 29 – Area Treatment

Location/Project Information:

Route/ Contract/ Project completion date: IL 29/ Contract 88707/ July 1998

District/ County/ Nearby towns: District 4/ Peoria County/ Mossville to Chilicothe

Direction/Lanes included in Experimental Section: All 4 Lanes

Stationing limits for Experimental Section(s): 15 + 345 to 26 + 975

Experimental Section Layout Information:

Existing pavement type and condition:

Description of any milling, patching, crack sealing, and other rehabilitation activities prior to placement of paving fabric and overlay lifts:

	Polymer Mixture	Conventional Mixture
Treated Section(s):		
Station limits:	15 + 345 to 21 + 147.3	21 + 147.3 to 22 + 350
Lane(s)/ direction:	All 4 Lanes	and 22 + 502.3 to 26 + 975 (4 lanes)
Untreated Section(s):		
Station limits:	17 + 797.6 to 21 + 147 .3	22 + 350 to 22 + 502.4
Lane(s)/ direction:	Both northbound lanes	Both northbound lanes

Overlay and Crack Control Information:

Total overlay thickness: 2.25 in. (57 mm), level binder plus surface

Average thickness of leveling binder: 0.75 in (19 mm), fabric placed on level binder

Asphalt mixture type(s): D-mix, Type II

Asphalt binder grade: AC-20 for conventional HMA, MAC-10 for polymer-modified mix

Fabric system: System A, Amoco Petromat, 4 oz/yd^2, Non-woven Polypropylene, Area Treatment

Experimental Sections Documentation
Reflective Crack Control Project

IL 40, Area Treatment

Location/Project Information:

Route/ Contract/ Project completion date: IL 40/ 64142/ February 1998

District/ County/ Nearby towns: District 2/ Bureau and Whiteside/ Deer Grove

Direction/Lanes included in Experimental Section: Both Lanes

Stationing limits for Experimental Section(s): 17 + 825.350 to 36 + 730.529

Experimental Section Layout Information:

Existing pavement type and condition: PCC with widening joints and a 1.5" bituminous overlay containing strip reflective crack control. Overlay showed reflective cracking coinciding with edges of strip treatment.

Description of any milling, patching, crack sealing, and other rehabilitation activities prior to placement of paving fabric and overlay lifts: No milling. Area treatment placed directly on existing overlay.

Treated Section(s):

Station limits/ Lane(s) direction: 17 + 892.670 to 36 + 730.529/ Northbound

Station limits/ Lane(s) direction: 17 + 825.350 to 36 + 730.529/ Southbound

Untreated Section(s):

Station limits: 17 + 825.350 to 17 + 892.670

Lane(s)/ direction: Northbound

Overlay and Crack Control Information:

Total new overlay thickness: 2.4 in. (60 mm) (level binder plus surface)

Avg thickness of leveling binder: 0.8 in (20 mm) level binder, above area treatment

Asphalt mixture types: Class I, Type 2, Mix D (Midwest Products), Level Binder Type II

Asphalt binder grade: AC-10

Fabric system (A, B, or C), placed in strip or area, and fabric brand name/ type/ weight:

System A, Amoco 4 oz/yd^2 Non-Woven Polypropylene, Area Treatment

Experimental Sections Documentation
Reflective Crack Control Project

US 34 – Area Treatment

Location/Project Information:

Route/ Contract/ Project completion date: US 34/ 64141/ September 1997

District/ County/ Nearby towns: District 2/ Bureau and La Salle/ La Moille and Mendota

Direction/Lanes included in Experimental Section: Both Lanes

Stationing limits for Experimental Section(s): 66 + 420.992 to 75 + 623 (Bureau) and 0 + 0.000 to 3 + 217 (La Salle)

Experimental Section Layout Information:

Existing pavement type and condition: PCC with overlay

Description of any milling, patching, crack sealing, and other rehabilitation activities prior to placement of paving fabric and overlay lifts: 1.5" Milling

Treated Section(s):

Station limits: 66 + 420.992 to 72 + 400.000 and 72 + 550.000 to 75 + 623 (Bureau) and 0 + 0.000 to 3 + 217.000 (La Salle)

Lane(s)/ direction: Both Directions

Untreated Section(s):

Station limits: 72 + 400 to 72 + 550 (Bureau)

Lane(s)/ direction: Both Directions

Overlay and Crack Control Information:

Total overlay thickness: 2" (level binder plus surface)

Average thickness of leveling binder (If applicable, estimate range of thickness if known): 0.75" (fabric placed on top of level binder)

Asphalt mixture type(s): Class I/ Type D

Asphalt binder grade used in surface mixture: AC-10

Fabric system (A, B, or C), placed in strip or area, and fabric brand name/ type/ weight:

System A, Amoco Petromat, 4 oz/yd^2, Area Treatment

Experimental Sections Documentation
Reflective Crack Control Project
ITRC IA-H1

Location/Project Information:

Route/ Contract/ Project completion date:

District/ County/ Nearby towns:

Direction/Lanes included in Experimental Section:

Stationing limits for Experimental Section(s):

Landmarks (if applicable):

Experimental Section Layout Information:

Existing pavement type and condition:

Description of any milling, patching, crack sealing, and other rehabilitation activities prior to placement of paving fabric and overlay lifts:

Treated Section(s):

Station limits:

Lane(s)/ direction:

Untreated Section(s):

Station limits:

Lane(s)/ direction:

Overlay and Crack Control Information:

Total overlay thickness:

Average thickness of leveling binder (If applicable, estimate range of thickness if known):

Asphalt mixture type(s):

Asphalt binder grade:

Fabric system (A, B, or C), placed in strip or area, and fabric brand name/ type/ weight: