THE PREFORMANCE OF CONTINUOUSLY REINFORCED CONCRETE PAVEMENTS IN TEXAS

by

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SUMMARY

Continuously Reinforced Concrete Pavements (CRCP) have been used extensively in Texas. First built in the early 1960's many of these pavements have reached the end of their initial performance period. In this report a study is made of the observed performance of these pavements around the State of Texas. Four Districts were chosen for detailed analysis these being the Beaumont, Paris, Amarillo and El Paso Districts. Each has many miles of CRCP and each has a markedly different climate. All the pavements evaluated were 8 inch thick CRCP pavements. The pavement performance was greatly affected by environment and material types. The life until major rehabilitation was between 17 and 19 years, with major pcc patching required throughout the pavement life. These figures would be appropriate for Life Cycle Costing calculations on equivalent pavements.

PREFACE

This study was prepared for the National Asphalt Pavement Association (NAPA). The contents of this report reflect the views of the author, who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the National Asphalt Pavement Association or any federal or state agency. This report does not constitute a standard, specification, or regulation.

TABLE OF CONTENTS

I INTRODUCTION

A keynote address (1) at a recent international pavement conference claimed that life cycle costing techniques clearly show concrete pavements to be more economic than asphalt pavements. This claim is frequently echoed particularly comparing the life cycle cost of Continuously Reinforced Concrete Pavements (CRCP) with that of an equivalent Asphalt Pavement. On close examination the assumptions made in the life cycle costing are suspect. A common assumption is that the CRCP pavement will last 30 years with only minor maintenance whereas the asphalt pavement will require several structural overlays to reach the same design life.

Until recently it has been impossible to obtain any objective information on the initial performance period and typical maintenance and rehabilitation costs of CRCP. This design became popular in the early to mid 1960's so it is only in recent years that sufficient performance data has become available to perform such an analysis. Providing quantifiable CRCP performance data is the aim of this study.

Since the 1960's the State of Texas has built many miles of CRCP pavement primarily on its high volume Interstate system. CRCP is popular today as many more miles of pavement are under construction particularly in the large urban areas where the critical concern is to provide a pavement that is as maintenance free as possible. In the early days of CRCP construction no widely accepted rational design procedure existed. Consequently the pavements constructed up to the mid 1970's were essentially the same pavement design, comprising an 8 inch thick CRCP slab with asphalt stabilized shoulders. Steel

reinforcing was generally kept constant. Although the above factors were kept constant, several other factors were varied in CRCP's constructed around Texas. These variable factors include;

(1) Coarse Aggregate Type - Two types of aggregate were commonly used depending on their availability. Both crushed limestone and siliceous river gravel have been used and have been observed to perform differently.

(2) Climate - A wide variety of climatic conditions exist in the State. The eastern districts receive 50 to 60 inches of rain annually. This progressively decreases moving westward. The far western districts receive less than 15 inches annually. A similar pattern exists with freeze-thaw problems. The northern districts receive in excess of 100 air freeze thaw cycles per year but the southern districts receive less than 10.

(3) Sub Slab Layers - Four types have been commonly used these being;

   a. Asphalt Stabilized (HMA)
   b. Unstabilized Natural Gravel
   c. Soil Cement
   d. Lime Stabilized

(4) Traffic Levels - The traffic loadings on pavements vary from location to location around the State.

To monitor the performance of its CRCP pavements the State of Texas has built and maintained a Rigid Pavement Data Base (2) which contains condition data on each mile of CRCP pavement within the State.

Maintained since the mid 1970's this data base is an excellent source of pavement performance data. This data base will be described in detail in a later section of this report.

The aim of this report is therefore to provide information on Life Cycle Cost information on CRCP in Texas. Of particular interest are;

(a) the time to first major rehabilitation

(b) the cost of rehabilitation

(c) the timing and cost of any maintenance prior to rehabilitation.

These topics will be discussed in this report which will be organized as follows. In the next section the inspection procedure used to evaluate CRCP performance will be presented. Photographs will be given to illustrate the various distress types. In the third section a brief discussion will be given of the factors known to influence CRCP performance. Reference will be made to the new AASHTO Design Guide (3) as well as recent research reports on the effects of aggregate type and rainfall. Sections 4 and 5 present the analysis of performance data at both the network level and project level. At the network level average performance data will be reported for four regions of the Texas. Project level performance will illustrate the typical performance cycle of individual pavement sections. Conclusions are presented in Section 6.

II CONDITION RATING OF CRCP

This section of the report describes the condition rating procedure used to evaluate the current condition of CRCP in Texas. Details of the procedure are given in a research report (4), a summary is presented here so that the reader will be familiar with the terminology used later in this report.

SURVEY PROCEDURE

The road is surveyed by two raters and a driver in one vehicle, travelling on the shoulder at approximately 15 miles per hour. The two raters keep track of the different distress manifestations. The road is surveyed in 0.4 mile sections, and then the data is then transferred to the field sheets or microcomputer.

CRCP DISTRESS TYPES

The distress types rated in the current Texas CRCP evaluation are severe spalling, severe punchouts, asphalt and PCC patches. These distresses are related to the structural character of CRCP. Such deficiencies as minor cracking, scaling and loss of skid resistance are not recorded in the evaluation.

Severe Spalling. Spalling is defined (4) as the widening of existing transverse cracks by secondary cracking or breaking of the crack edges. The severity of the crack is determined by the width of the spall. Only cracks in which the spall has widened by an inch or more are counted. The whole crack is defined by the most severe condition, the presence of only a small length of spalling which is wider than one inch defines that crack as severely spalled. Spalled cracks are shown in Figure 1 and 2.

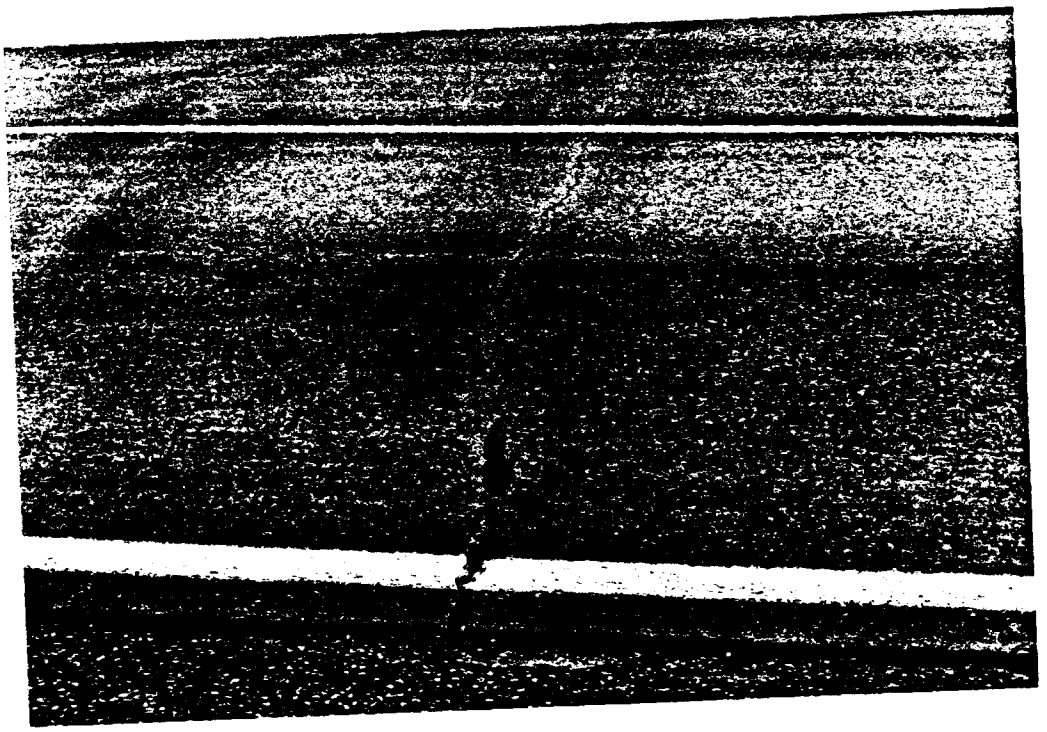

Figure 1. The small length of spalling would qualify this as severe spalling.

Figure 2. Closely spaced severely Spalled Cracks.

Figure 3 shows a section of highway with numerous spalled cracks in the passing lane and with relatively few in the travel lane. The mechanism by which the initial transverse cracks forms is fairly well known. Indeed the reinforcing steel design is aimed at providing tight transverse cracks at 4 to 8 foot crack spacings. What is not well known is why some of these cracks become severely spalled. Figure 3 indicates that traffic is only a secondary factor to the primary factors of environment, aggregate types, mix design and construction techniques.

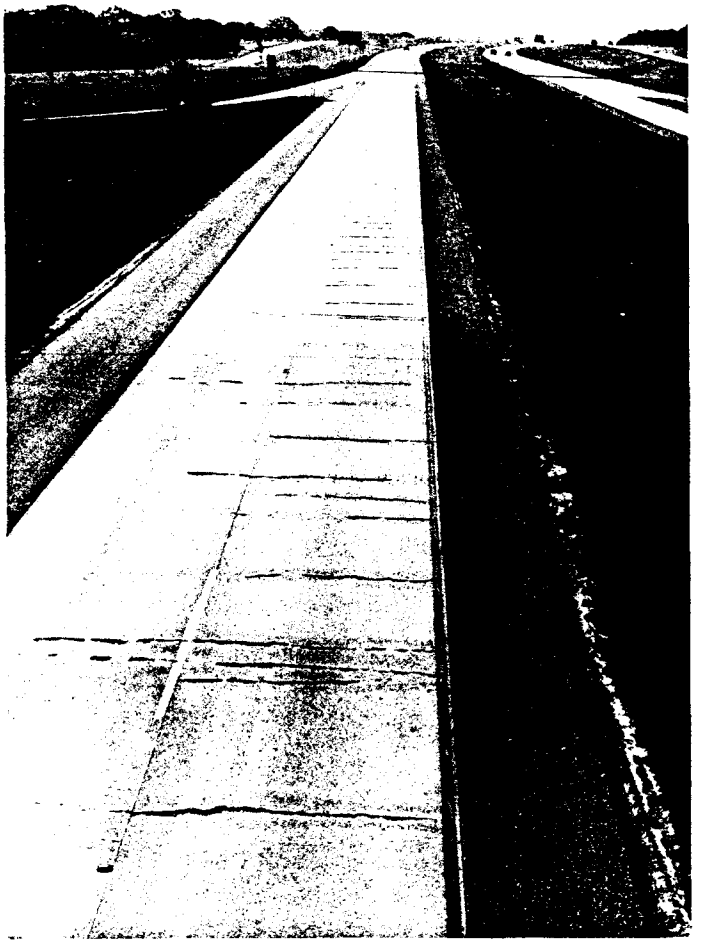

Figure 3. Severe Spalling largely in the passing lane.

Severe Punchouts. When closely spaced transverse cracks are linked by longitudinal cracks to form a block, the block is called a punchout. Although not exclusive to CRCP, punchouts seem to appear more frequently in CRCP than in jointed pavements. Punchouts are considered the most severe structural problem associated with CRCP.

Punchouts are invariably associated with either short transverse crack spacings [less than 2 ft] or with Y-cracks as shown in Figure 4.

Figure 4. Y-cracking in CRCP

Short crack spacing and Y cracks are not always the forerunners of punchouts and in some cases they never become associated with punchout failures. However they are viewed as potential sites of future punchout problems. If future problems are expected some states prefer to perform preventative maintenance at this stage to postpone or eliminate punchout development. Treatments such as undersealing with asphalt or cement grout, improvement of drainage and crack sealing are common, but of unknown effectiveness.

In the Texas rating system (4), a minor punchout is defined as a condition where, although a block has formed, no sign of movement under traffic is apparent. The cracks surrounding the punchout are narrow. In a severe punchout, the surrounding cracks are fairly wide and pumping or severe spalling around the edges may be present. This is caused by the movement of the punchout block under traffic loads. Figure 5 shows a severe punchout, wide cracks such as these could indicate that steel rupture has occurred.

In Texas, only the number of severe punchouts per section are recorded. A long punchout can be recorded as a number of smaller punchouts if the longitudinal crack has a distinct offset (4). A potential multiple punchout is shown in Figure 6.

Figure 5.-
Severe Punchout

Figure 6. Multiple Punchouts in CRCP

Asphalt and Portland Cement Repair Patches. Severe punchouts require removal of the damaged area, restoration of the base, possibly the addition of drainage and a permanent patch. In Texas a repair patch is defined as a repaired section of pavement where the repair work has been carried out to the full depth of the concrete. Hot Mix Asphalt (HMA) patches, CRCP patches and failed patches are counted separately. The size of the patch is not recorded although frequently PCC patches cover the full lane and are 10 to 15 feet in length as shown in Figure 7. Reference (5) gives a good description of the recommended CRCP repair procedure.

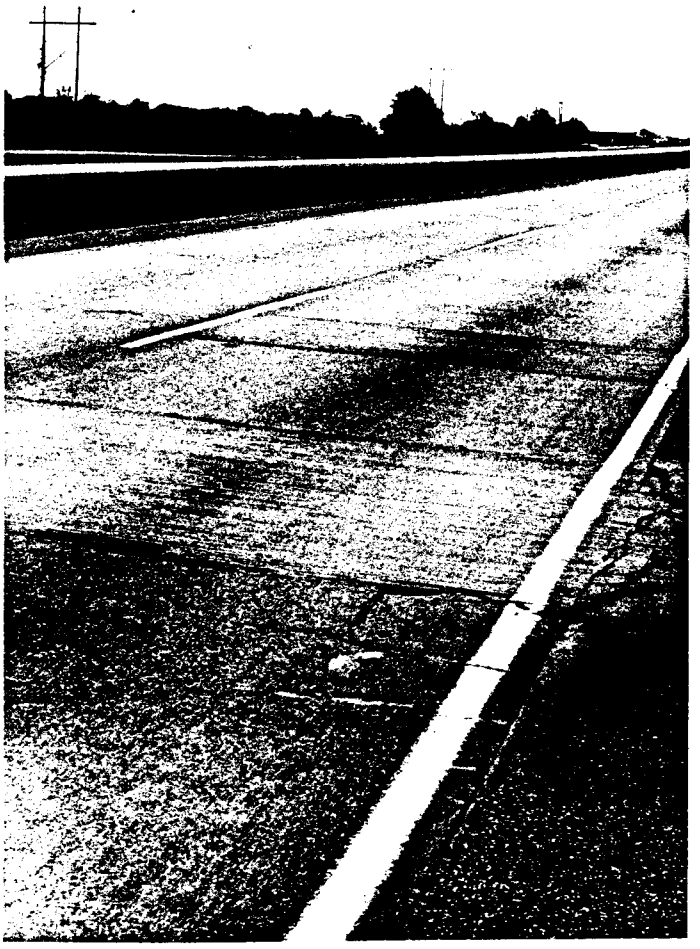

Figure 7. Typical PCC repair patches in CRCP

RIGID PAVEMENT DATA BASE

Distress data has been collected since 1974 on all rigid pavements on the Interstate System and some selected pavements on U.S. and State Highways. Surveys were made in 1974, 1978, 1980, 1982 and 1984. Figure 8 shows that most of the Texas districts have some CRCP pavement. The total miles of CRCP surveyed district-wide is estimated to be 1893 miles (2).

The collected data is stored in a database which was transferred to microcomputer for this project. As described in (2) the following data items are stored in this data base.

Section Identification Data

1. District Number
2. Control Number (CTRL)
3. Section Number (SEC)
4. Highway Number (HWY)
5. Construction Date (CONST DATE)
6. Direction of Travel
7. County (COUNTY)
8. Job Number (JOB)
9. Project ID Number (CFTR NO.)
10. Date of Survey (SURVEY DATE)
11. Location Info.
12. Raters Name
13. Total Project length (TOTAL)
14. Unoverlaid length (UNOVL)

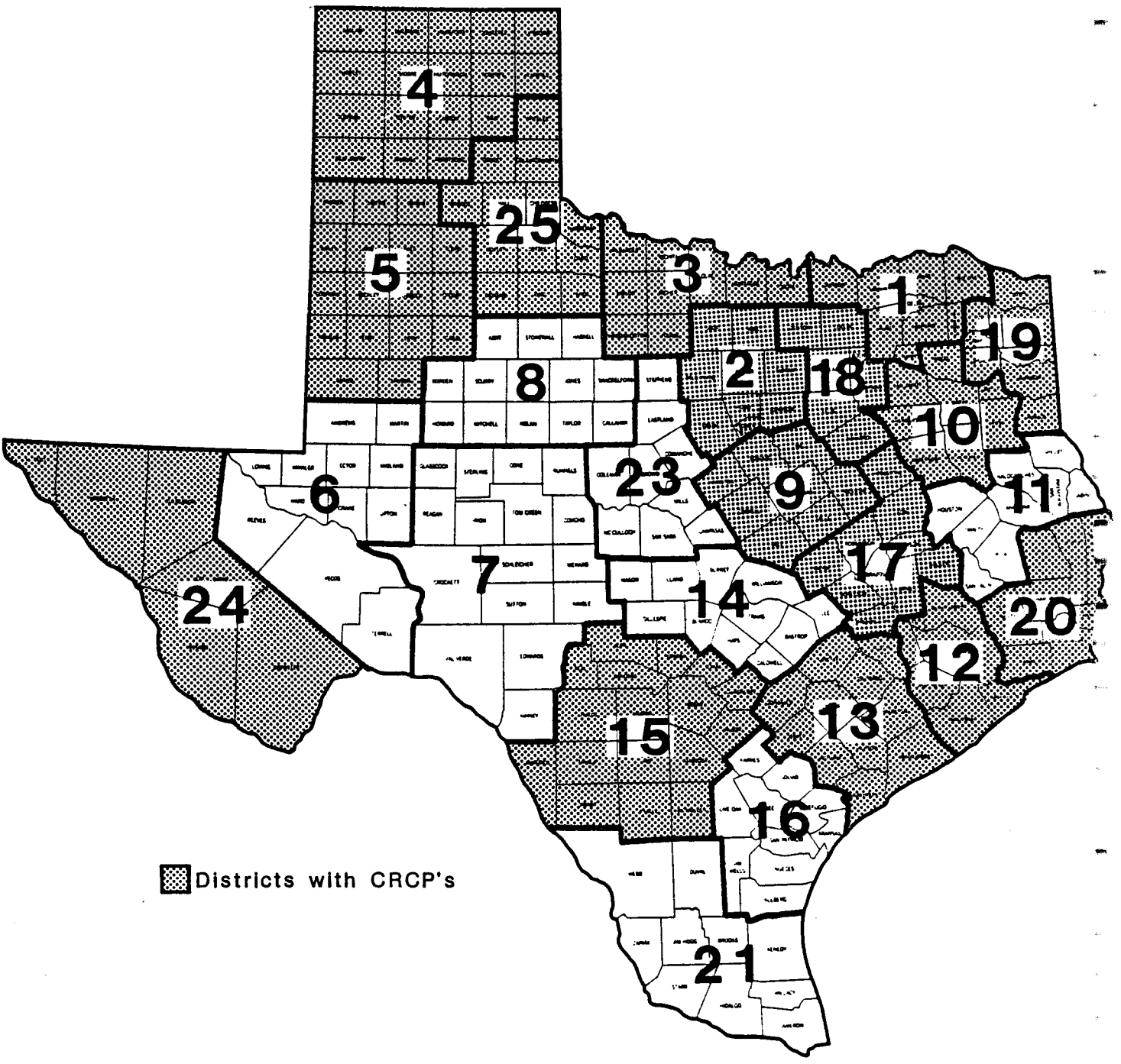

Figure 8. Texas districts which have Continuously Reinforced Concrete Pavements (1)

CRCP Inspection Data

1. Number of Spalled Cracks per mile

   (minor and severe) (Only severe counted from 1984 on)

2. Number of Patches per mile

   (ACC, PCC and Failed)

3. Number of Punchouts

Typical output reports from this system are shown in Figures 9 and 10.

DISTRICT 25

CFTR NO.	HWY	COUNTY	CTRL	SEC	JOB	LENGTH	CONST DATE
25003	WB IH-40	WHEELER	275	12	31	1.6	1973
	(SHAMROCK(JCT US-83) TO 1 MI W OF FW &D R.R.)						
25003	EB IH-40	WHEELER	275	12	31	2.4	1973
	(1.0MI W OF FW AND D R.R. TO SHAMROCK(JUNCTION US-83))						
25004	EB IH-40	WHEELER	275	13	29	1.6	1973
	(SHAMROCK(JCT. US-83) TO 1.0 MI EAST OF SHAMROCK)						
25004	WB IH-40	WHEELER	275	13	29	1.6	1973
	(1 MI E OF SHAMROCK TO SHAMROCK (JCT US-83))						
25005	EB IH-40	WHEELER	275	12	32	.8	1975
	(MILE POST 176- TO OKLAHOMA STATE LINE)						
25005	WB IH-40	WHEELER	275	12	32	.8	1975
	(TEXAS STATE LINE TO MILE POST 176)						
25002	EB IH-40	WHEELER	275	13	24	12.4	1970
	(1.0 MI EAST OF SHAMROCK TO OKLAHOMA STATE LINE)						
25002	WB IH-40	WHEELER	275	13	24	12.4	1970
	(OKLAHOMA STATE LINE TO 1 MI E OF SHAMROCK)						
25001	EB IH-40	WHEELER	275	12	20	14.0	1968
	(GRAY COUNTY LINE TO .9 MI W OF FW AND D RR)						
25001	WB IH-40	WHEELER	275	12	20	14.4	1968
	(.9 MI W OF FW AND D RR TO GRAY COUNTY LINE)						

Figure 9. Section Location information from Texas CRCP data (2)

Figure 9 gives the section identification information, the section length and the date of construction. For each section identified the pavement performance data is presented in the failure summary report (Figure 10)

FAILURE SUMMARY FOR DISTRICT 25

CFTR NUMBER	CONST. DATE	SURVEY DATE	LENGTH TOTAL	LENGTH UNOVL	SPALLING (PER MILE) MINOR	SPALLING (PER MILE) SEVERE	PATCHES (PER MILE) AC	PATCHES (PER MILE) PCC	PATCHES (PER MILE) FLD	PUNCHOUTS (PER MILE)	FAILURES PER MILE	FAILURES TOTAL
25003WB	1973	1984	1.6	1.6	0	2.5	0	1.3	0	.6	0	0
		1982	1.8	1.8	168.9	.6	0	.6	0	0	0	0
		1978	1.8	1.8	146.1	.6	0	0	0	0	0	0
		1974	1.8	1.8	0	0	0	0	0	0	0	0
25003EB	1973	1984	2.4	2.4	0	8.7	.8	.4	0	0	1.3	3.0
		1982	2.8	2.8	211.8	.7	.4	.4	0	0	.7	2.0
		1978	2.8	2.8	211.8	.7	0	0	0	.7	.7	2.0
		1974	2.8	2.8	0	0	0	0	0	0	0	0
25004EB	1973	1984	1.6	1.6	0	7.5	1.3	1.3	0	0	2.5	4.0
		1982	1.6	1.6	156.3	.6	0	.6	0	.6	1.3	2.0
		1978	1.6	1.6	156.3	.6	0	0	0	.6	.6	1.0
		1974	1.6	1.6	0	0	0	0	0	0	0	0
25004WB	1973	1984	1.6	1.6	0	6.3	.6	.6	.6	1.3	3.1	5.0
		1982	1.6	1.6	130.0	.6	0	.6	0	0	.6	1.0
		1978	1.6	1.6	130.0	.6	0	.6	0	0	.6	1.0
		1974	1.6	1.6	0	0	0	0	0	0	0	0
25005EB	1975	1984	.8	.8	0	0	0	0	1.3	0	1.2	1.0
		1982	.9	.9	188.9	0	0	0	0	0	0	0
		1978	1.0	1.0	67.0	0	0	0	0	0	0	0
25005WB	1975	1984	.8	.8	0	2.5	0	0	1.3	0	1.2	1.0
		1982	1.0	1.0	130.0	0	0	0	0	0	0	0
		1978	1.0	1.0	86.0	0	0	0	0	0	0	0

Figure 10. Typical Failure Summary Report (District 25)

This report contains a wealth of information on the performance of each section. For example the TOTAL LENGTH can be compared with the UNOVL LENGTH to determine at what age overlays are being placed. The failures per mile is the summation of patches (AC, PCC, Failed) plus punchouts per mile. Note in this printout the rating of minor spalling was discontinued in 1984.

The information presented in Figure 10 is for relatively new CRCP still in good condition. Contrast this with the information shown in Figure 11 for older CRCP in the Beaumont area of Texas, District 20.

FAILURE SUMMARY FOR DISTRICT 20
(CONTINUED)

CFTR NUMBER	CONST. DATE	SURVEY DATE	LENGTH TOTAL	LENGTH UNOVL	SPALLING (PER MILE) MINOR	SPALLING (PER MILE) SEVERE	PATCHES (PER MILE) AC	PATCHES (PER MILE) PCC	PATCHES (PER MILE) FLD	PUNCHOUTS (PER MILE)	FAILURES PER MILE	FAILURES TOTAL
0004EB	1963	1982	9.6	0.4	0.0	0.0	0.0	0.0	37.5	0.0	37.5	15.0
		1980	9.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1978	9.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1974	8.2	8.2	0.0	0.0	6.0	6.8	0.0	2.7	15.5	127.0
0009EB	1964	1982	8.2	0.0	—	—	—	—	—	—	—	—
		1980	8.2	8.2	280.4	3.3	1.7	11.8	0.0	8.4	22.0	180.0
		1978	8.2	8.2	280.4	2.4	7.7	4.3	0.0	0.5	12.4	102.0
		1974	8.2	8.2	0.0	0.0	0.6	1.1	0.0	1.1	2.8	23.0
0017EB	1967	1982	1.0	1.0	71.0	346.0	0.0	0.0	15.0	0.0	15.0	15.0
		1980	0.9	0.9	38.9	376.7	0.0	0.0	0.0	0.0	0.0	0.0
		1978	0.9	0.9	38.9	376.7	0.0	0.0	0.0	0.0	0.0	0.0
		1974	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0018EB	1967	1982	3.0	3.0	90.3	362.3	0.3	0.7	5.0	0.0	6.0	18.0
		1980	3.0	3.0	90.3	346.7	0.0	0.3	0.0	0.3	0.7	2.0
		1978	3.0	3.0	76.3	236.7	0.0	0.3	0.0	0.0	0.3	1.0
		1974	3.0	3.0	0.0	0.0	0.3	0.0	0.0	0.3	0.7	2.0
0021EB	1969	1982	5.0	4.6	213.5	230.7	0.2	0.0	3.3	0.4	3.9	18.0
		1980	5.0	4.6	214.3	230.7	0.0	0.2	0.0	1.7	2.0	9.0
		1978	5.0	4.6	180.2	155.4	0.0	0.0	0.0	0.2	0.2	1.0
		1974	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 11. Failure Summary Report (District 20)

In sections 5 and 6 of this report statistical summaries of CRCP performance data will be presented. Two parameters used to report performance are:

(1) The failures per mile per year

(2) Time until 50% of section received an overlay.

To illustrate the calculation of these parameters refer to the data presented in Figure 11 for the section with CFTR Number 0009EB. The section was constructed in 1964 and the entire 8.2 mile section received an overlay in between 1980 and 1982. In this case 1981 would

be assumed to be the overlay date. Therefore the "Time until 50% overlay" would be set to 17 years (1981 - 1964). For most pavements the entire pavement is not overlaid at the same time so a plot of percentage overlaid versus time is made and the 50% percentile is calculated.

To calculate the Failures per mile per year the total number of failures in the year before overlay is obtained from Figure 11. For Section 0009EB a total of 180 failures were counted in the 1980 survey. At that time the section length was 8.2 miles and the age was 16 years (1980-1964). Thus the Failures per year per mile is calculated as 180 divided by 16 divided by 8.2. This computes to be 1.37 failures per mile per year. This assumes that the growth of failures is linear which it is not, but for the scope of this study this number is a reasonable estimate of pavement performance.

III FACTORS AFFECTING PERFORMANCE

The last section of this report introduced the distress types found in CRCP pavements in Texas. In this chapter a summary will be given of previous CRCP performance studies in Texas. The high severity distresses in CRCP, such as punchouts, are frequently progressive failures. First observed as close-spaced transverse or "Y-Cracks" which, under the influence of traffic and environment, deteriorate to form a punchout. The cause of transverse cracks is fairly well known and the AASHTO reinforcement design procedure (3) attempts to design tight transverse cracks with a spacing of 4 to 8 ft. What is not well known is why the designed transverse cracks sometimes rapidly deteriorate and become the focal point of more serious distresses. Recent research in Texas has indicated other key factors such as coarse aggregate type and rainfall have significant influence on the pavement deterioration process.

PREVIOUS PERFORMANCE STUDIES OF CRCP IN TEXAS

Perhaps the most comprehensive study of CRCP performance was that performed by Machado (7) in 1977. He collected performance, materials, design, traffic and environmental data on 86 sections of rural 8 inch thick CRCP. By using regression techniques he produced a series of equations which related measured performance (Failures, Roughness (PSI) and Spalling) to the materials, design and environmental variables. An example of these regression equations is shown below:

$$\begin{aligned}\text{Failures (Sq ft/mile)} = {} & 0.62 + [1.74\ (\text{clay severity}) - 0.77\ (\text{Region 7}) \\ & + 0.003\ (\text{temperature constant}) \\ & + X_1\ (\text{Pavement coarse aggregate})\end{aligned}$$

- 0.31 (central mix for concrete)

- 0.25 (internal vibration for concrete)

0.62 (asphalt concrete subbase course)

+0.46 (subbase centrally mixed)

+ X_2 (subbase material)

+ X_3 (subbase stabilization)

+ X_4 (shoulder base type)

+ X_5 (shoulder base stabilization)

+ 0.61 (subgrade layer thickness in inches)]

+ [0.02 (current failure condition

in sq. ft/mi) .(time increment in months)]

where

X_1 = 0.55, if, siliceous river gravel (GR) used,
-2.13, if crushed limestone (LI) used,
0.17, if GR + LI used
0, if other aggregate used;

X_2 = 2.00, if pit run gravel used,
1.08, if limestone material used,
0.89, if oyster shell used, and
0, if other subbase material used;

X_3 = -0.46, if asphalt used,
-0.15, if lime used, and
0, if cement used or not stabilized;

X_4 = -0.90, if flexible shoulder base used,
1.68, if foundation course used, and
0, if other shoulder base type used; and

X_5 = -0.67, if cement used,
1.95, if lime used, and
0, if asphalt or no shoulder base stabilization used.

Equations of this type are useful in highlighting factors which influence the field performance of CRCP pavements. From a review of the equations presented in (7) the following conclusions are of note;

1. The traffic effect was insignificant (8). This would imply that the main causes of pavement deterioration were

environmental, or materials related. Of the models presented by Machado (7) the accumulative traffic only entered the spalling model which is the distress that would have been least expected to be dependent of traffic loadings (see Figure 3). The fact that performance was observed to be independent of 18-kip loadings is an interesting observation. What consequence this has on thickness design merits consideration.

2. Some variables had a strong relationship to performance. Subbase type, concrete coarse aggregate type and presence of active clays were important parameters in both the Failures and Roughness Models. For example the value of X_1 is 0.55 for siliceous river gravel and - 2.13 for crushed limestone, this factor alone see Figure (12) has significant impact on the areas of failure expected in the pavement.

A more recent study on CRCP performance in Texas is that of Torres-Verdin et al (9). The aim of this work was to evaluate the effect of coarse aggregate type on CRCP performance. In Texas, two types of coarse aggregate are commonly used in CRCP, these being crushed limestone and silicious river gravel. In recent years, it has been noted from the annual performance data that the pavements made with the limestone have had superior performance to those made with river gravel. However aggregate type is not a variable in the slab thickness design process. The selection of coarse aggregate type is often left to the contractor without evaluating the consequences of using an aggregate whose properties were not considered in the design stage. Torres-Verdin et al, evaluated three approaches for estimating

thickness equivalencies for CRCP. In summary they concluded that each approach gave similar results namely that 10% more slab thickness would be required to equate limestone and siliceous river gravel performance. For example, if a 10 inch limestone slab were designed then an 11 inch siliceous river gravel slab would be required to ensure similar performance. In one of the three approaches the regression equations developed by Machado (7) were used to predict performance. The results are reproduced below in Figure 12.

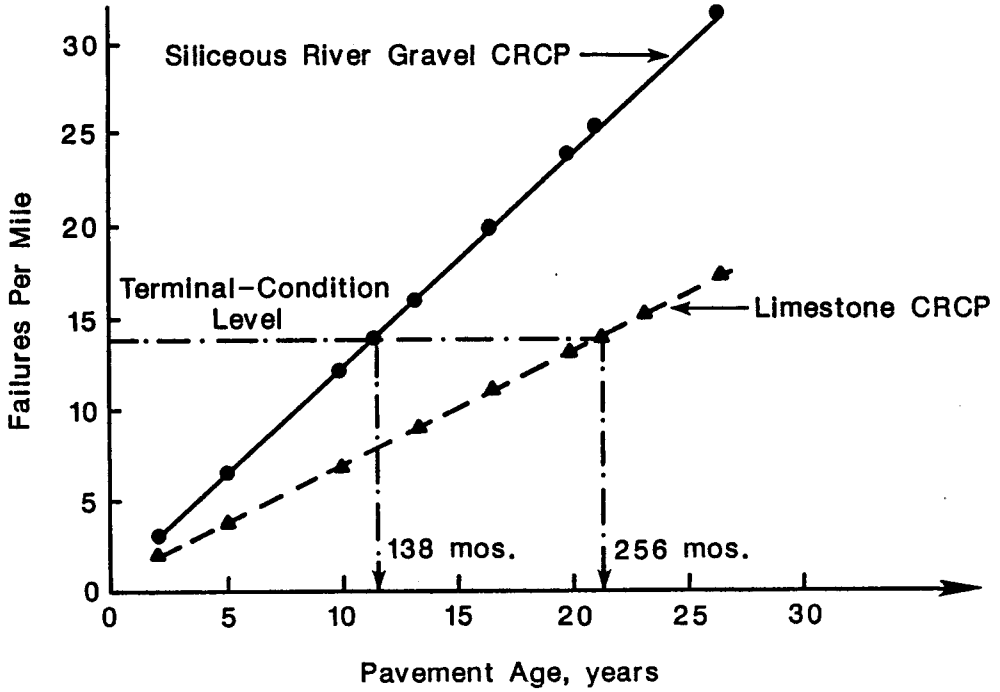

Figure 12. Predicted performance of CRCP pavements (9) using regression equations developed by Machado (7)

The value of 14 failures per mile was recommended (11) as the critical level at which the CRCP should require an overlay. (Although this number is thought appropriate for rural highways it appear high for urban highways.) As noted in Figure 12 this is reached in 11.5 years for a pavement constructed using siliceous river gravel and 21.3 years for an equivalent thickness limestone pavement.

The effects of rainfall on CRCP performance was reported by Saraf (12) at the 1987 TRB Conference. Saraf studied 10 years of CRCP performance data from the Texas CRCP Data Base and correlated the average rate of failures per mile per year (RFPM) for each district with the annual average recipitation (P) of the District. The following equation was obtained;

$$\log (RFPM) = -4.05 + 2.35 \log (P) \qquad R^2 = 0.94$$

This relationship is shown graphically in Figure 13 (taken from reference (12))

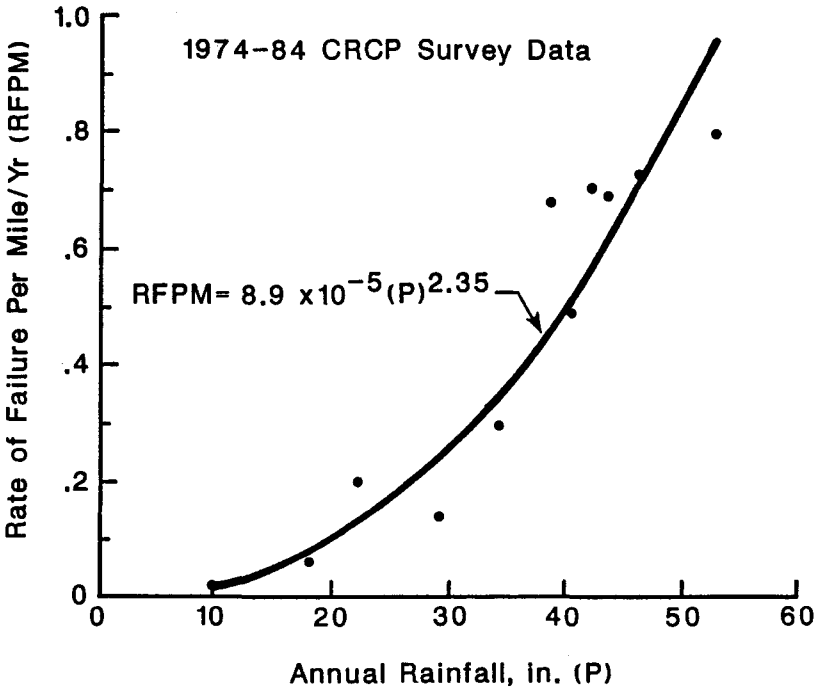

Figure 13. Correlating Failures per mile per year with Rainfall (12)

Using this equation and failure criterion of 14 failures per mile for rural higways and 10 failures per mile for urban highways it is possible to calculate the time till failure under different rainfall conditions. These results are tabulated below.

Table 14. Predicted Time to Failure using the results of Saraf (12).

Rainfall in/year	Failure/Mile/ year	Time to Failure (Years)	
		Rural	Urban
30	0.263	53.2	38.0
40	0.518	27.0	19.3
50	0.876	15.9	11.4
60	1.34	10.4	7.5

SUMMARY

In this chapter several factors, which have been observed to affect the performance of CRCP in Texas, have been discussed. Machado (7) noted that accumulative traffic loadings appeared to have little effect on pavement performance. Torres-Verden (9) studied the effect of coarse aggregate type and Saraf (12) reported on the effects of climate. Clearly everything is not known about the factors affecting CRCP performance and more work, perhaps of a more fundamental nature, is required to understand more fully the field performance data.

IV NETWORK LEVEL PERFORMANCE OF CRCP IN TEXAS

Network level performance is defined as the average performance of all the CRCP within a given area of the State. The State of Texas is divided into 24 districts and the four districts shown in Figure 14 were selected for this study. These districts being District 20 (Beaumont), District 1 (Paris), District 4 (Amarillo) and District 24 (El Paso). These districts were selected for two reasons, firstly their geographic distribution ensures that there is a range of climatic conditions and secondly each has a considerable mileage of CRCP.

CLIMATIC CONDITIONS

District 20 (Beaumont) is located in the flat coastal plain in the extreme southeast corner of Texas. This District's climate is a mixture of tropical and temperate zone conditions. Sea breezes prevent extremely high summer temperatures and the area lies far enough south so that the winters are moderate. Average maximum/minimum temperatures range from low sixties/mid forties in January to low nineties/low seventies in summer. The rainfall is normally distributed throughout the year with a annual total of around 55 inches.

District 1 (Paris) is located in the north east of Texas. The climate is humid, subtropical with hot summers. It is characterized by a wide range in annual temperature extremes, winters are mild, but "northers" occur several times each winter month accompanied by a sudden drop in temperature. Rainfall is annually around 45 inches per year, a large part of which results from thunderstorm activity. Greatest amounts occur in April and May.

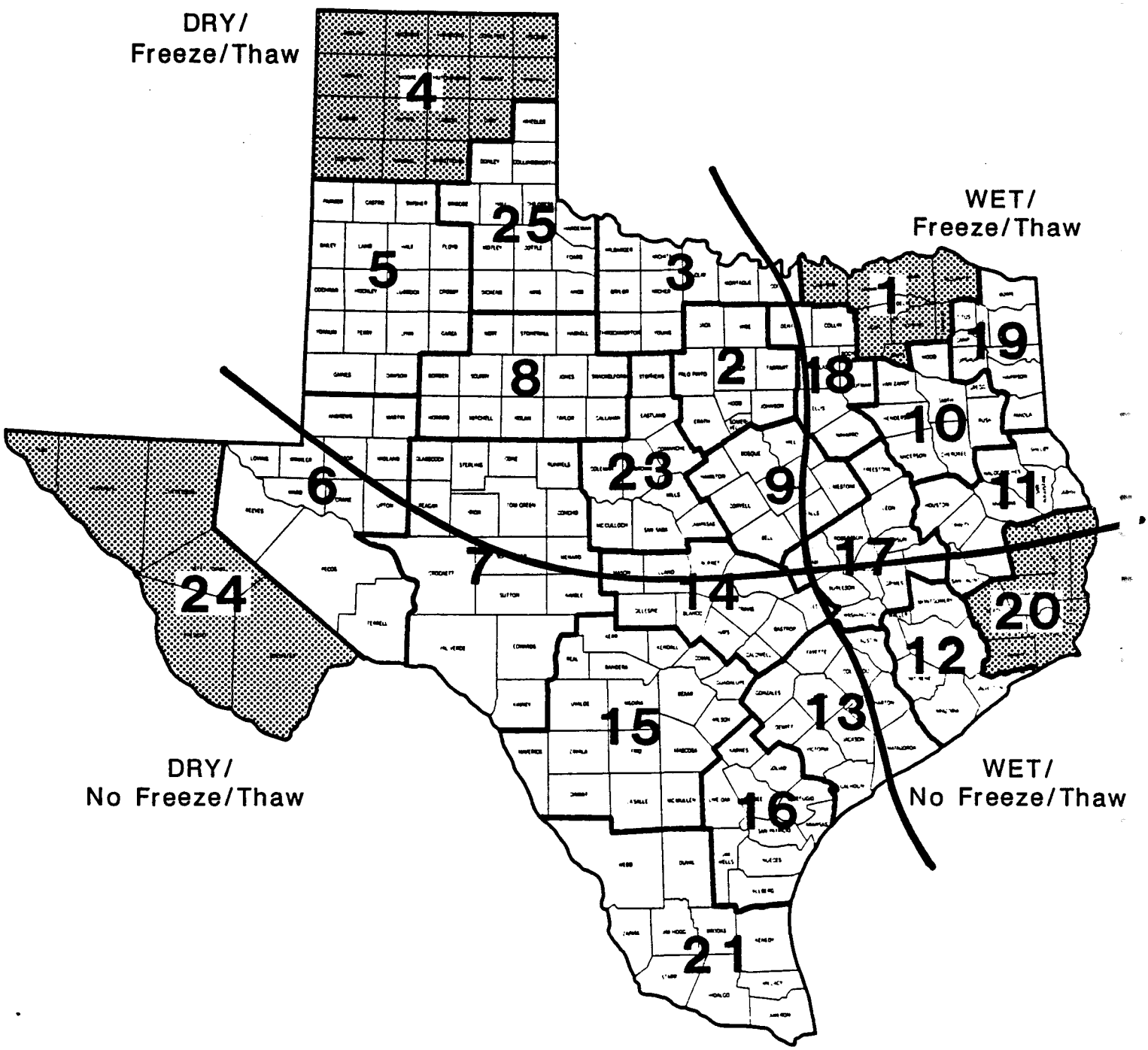

Figure 14. Districts included in NAPA Study
(with climatic zones)

District 4 (Amarillo) is subject to frequent and rapid temperature changes in winter. Temperature drops of 50 to 60 degrees in a 12-hour period are not uncommon. The average snowfall is close to 12 inches per year with total average rainfall of 20 inches per year. The max/min temperatures range from low nineties/mid sixties in summer to high forties/low twenties in winter.

District 24 (El Paso) is located in the extreme west point of Texas at an elevation over 3500 feet. The area is characterized by an abundance of sunshine throughout the year, scanty rainfall and relatively mild winters. Rainfall is generally less than 10 inches, half of which falls in July-September. Dry periods of several months are not uncommon.

A summary of these districts' climatic data is shown below in Figure 15.

District Climate	20	1	4	24
Rainfall ins/year	55	45	20	10
Air Freeze/Thaw Cycles per year	10	37	80	50

Figure 15. Summarized Climatic Data from Districts in NAPA Study.

In general the subgrade conditions in West Texas are more favorable for highway construction than in east Texas. District 20 (Beaumont) has relatively poor clay subgrades and little high quality base material, haul distances for quality crushed limestone aggregates

are over 200 miles therefore local siliceous river gravels are frequently used. Expansive clays are present throughout most of Texas and several highways in District 1 and 24 have reported pavement roughness problems associated with swelling clay.

DISTRICT PERFORMANCE DATA

For each District in the study a review was made of the performance of every section of CRCP in that District. For each District the following four tables are produced.

1. "Miles Surviving without Overlay" which lists for each project the number of miles which was unoverlaid for each year.
2. "Survivor Curve for CRCP" which summarizes for each District the percentage of the total mileage surviving without an overlay.
3. "The Percentage of CRCP overlaid" which shows the overlay schedule.
4. "The Failure Summary Chart" which shows for each project the average failures per section per year and the failures per mile per year.

These tables are shown in Appendix A. Figures A1 through A4 are the results from District 20 (Beaumont, Texas), Figures A5 through A8, A9 through A12 and A13 through A16 are for Districts 1, 4 and 24 respectively.

Figure A1, lists the miles surviving without overlays in each section of District 20 for each year for which data is available. The results are summarized as percentages surviving in the bottom line of

this table. The rules used to construct this table and calculate the percent surviving are as follows:

1. Include all data up to last date of inspection (usually 1984). Do not project trends into the future. If a highway section has some unoverlaid sections, drop its mileage from table following the last inspection date. For example, consider section 0004EB in Figure A1. The last inspection data showed that 0.4 miles of the original 9.6 miles had not received an overlay in the 19th year after construction. As data was not available for year 20 this section was dropped and the 9.6 miles was excluded from the TOTAL MILES at the bottom of the table.
2. When a section was completely overlaid (0009EB, Figure A1) the 0.0 miles remaining was continued until the end of the analysis period. The beginning initial mileage was included in the TOTAL MILES calculation.
3. There are often two and sometimes four years between inspections. Linear interpolation was used between inspection periods. For example if in year 15, eight miles of a section were reported as unoverlaid and in year 17, six miles were unoverlaid, then the length unoverlaid in year 16 was estimated to be seven miles. The results of Figure A1 are shown in Figures A2 and A3.

Figure A2 is a survivor curve which shows the percentage of mileage remaining after each year in service. The 50th percentile is reached in approximately 17 years. Figure A3 shows the percentage of the highways that received an overlay each year.

The implication for life cycle cost analysis is as follows. For every one mile section on CRCP built in District 20 on average one can expect to overlay 1/2 mile in year 17 and the remainder in year 21. It must be remembered that the term "overlay" does not simply involve placing an asphalt overlay. Considerable concrete patch work of failed areas is required before placement of the HMA. The average number of failures per year for each section was computed to provide an indication of the amount of failures occurring throughout the first performance period of CRCP (life until first overlay). This was computed by dividing the total number of failures before overlay by the age of the pavement. The results for District 20 are shown in Figure A4. This figure has four columns. These are the section identification, the number of miles in each section, the number of failures per mile per year and the number of failures per section per year (Column 1 X Column 2). The average failures per mile per year is obtained by summing the number of failures per section per year and dividing by the total number of miles. For District 20 the number of failures per mile per year was 0.89.

Based on the average performance of CRCP pavements in District 20 the following life cycle restoration measures for 1 mile of highway could be anticipated.

Year 10	Repair 9 failures (dig out and place a concrete patch)
Year 17	Repair 6 failures and overlay 50% of Section
Year 21	Repair 3 failures Overlay remaining 50% of section

SUMMARY OF NETWORK PERFORMANCE

The survivor curves shown in Figures A2, A6, A10 and A14 are combined below in Figure 16.

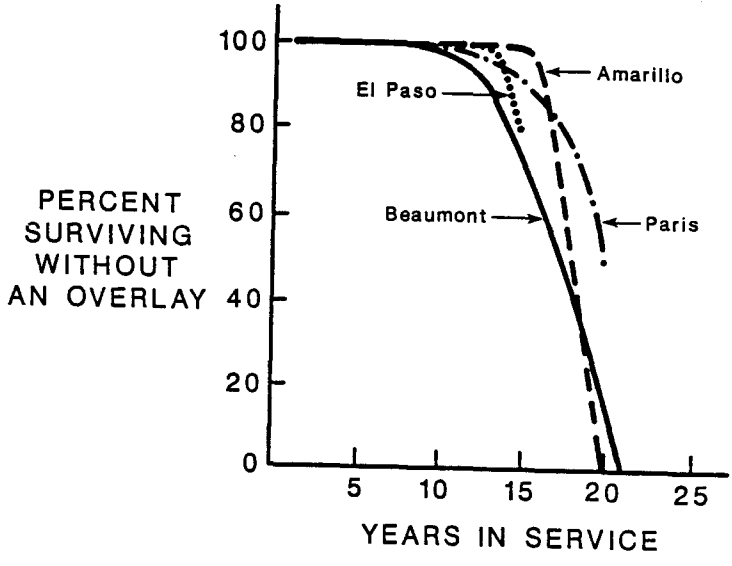

Figure 16 Comparing the performance of CRCP in 4 Districts in Texas

The anticipated performance of CRCP in each district is summarized below in Figure 17.

District	Failures repaired in year 10	Time till 50% Overlay	Time till 100% overlay
20 (Wet/No Freeze Thaw)	9	17 (+6 Failures)	21 (+3 Failures)
1 (Wet/Freeze Thaw)	4	19 (+ 4 Failures)	-
4 (Dry/Freeze Thaw)	3	18 (+ 2 Failures)	20 (+ 1 Failure)
24 (Dry/No Freeze Thaw)	<1	-	-

Figure 17. Projected Performance for 1 mile of CRCP in each District.

V PROJECT LEVEL PERFORMANCE OF CRCP IN TEXAS

At the project level, detailed evaluations are made of the performance of individual pavement sections. Attempts are made to develop empirical or mechanistic models which link the design/climate/materials/traffic variables to the observed pavement performance. With data of sufficient quality and quantity it is possible to develop or validate complete pavement design procedures with these models. Two typical examples of project level evaluations are:

(a) to evaluate the influence of a key variable (coarse aggregate type, traffic loading or slab thickness) on pavement performance

(b) to develop deterioration rates for pavement sections to be used within Pavement Management Systems.

There are a multitude of uses for quality project level performance data. With the vast amounts of money spent on the U.S. Highway System, it is truly amazing that little consistent effort has gone into long term pavement performance monitoring. Trying to study performance after the fact is often a frustrating business. Often key design information or original laboratory data are frequently not available. The only significant rigid pavement data base of note is the COPES (13) system assembled by researchers at the University of Illinois. The focus of that system is primarily upon the performance of Jointed Concrete Pavements.

In this section the aim is to assemble a small CRCP data base from pavements around the State of Texas. In total 24 pavement sections were selected for detailed study, 6 from each of the four study districts. The only criteria used to select sections was that each

should be at least 2 miles in length and that within any district there should be a range of construction dates.

DETAILED PROJECT-LEVEL INFORMATION

The project level performance data is shown in Appendix B. For each one of the 24 projects the following information was collected;

1. Project Identification which includes project location information
2. Geometric Information which contains layer thicknesses, lane and shoulder widths, shoulder types etc.
3. Original Construction Data which includes date and original construction cost ($ per direction mile, usually 2 lanes), steel configuration, base, subbase and subgrade types.
4. Materials Information containing information relating to the types of aggregate used, concrete and steel strengths, cement factor, slumps and method of curing.
5. Major Maintenance or Rehabilitation data describing the dates, costs and type of work performed on the section.
6. Pavement Conditions which includes, where available, comments on the current condition of the existing highway with information on planned overlay dates.
7. Average Climatic Conditions giving information on rainfall and air freeze thaw cycling.
8. Traffic Data which includes current ADT (2 directions), current percentage trucks, estimated 18 kip Equivalent Single Wheel Loads in the Design Lane from construction to current and to date of rehabilitation.

9. Pavement Performance Data for each year in which inspection data is available. This section includes information on the percentage of section length surviving without an overlay, the number of severe spalls per mile and the number of failures per mile.

The following should be noted;

(a) All the concrete pavements included were 8 inches thick with bituminous shoulders.

(b) All had similar reinforcing.

(c) No subgrade information is presently available.

MODELLING PAVEMENT PERFORMANCE

The approach used to model pavement performance data is as follows:

(1) The performance variable of interest (Y = Failures per Mile) is plotted against the independent variable of interest (X = TIME) and a form of performance equation is defined, typical forms include;

LINEAR $Y = A + BX$

POWER $Y = AX^B$

(2) For each section the values of constants A and B are calculated using regression or other techniques. These constants have physical meaning for example B in the Linear model is a rate of growth of failures.

(3) Once the values of A and B are calculated, regression techniques are again used to attempt to explain the variations in these parameters. Regression equations are

built to link the A and B parameters to factors such as the traffic loadings, environmental conditions and design thicknesses. The final design equation is of the form

$$B = C_1 X_1 + C_2 X_2 + C_3 X_3 +$$

where B is growth in failures per mile

and X_1 = traffic rate

X_2 = aggregate type

X_3 = rainfall, etc.

C_1, C_2, C_3 are regression constants.

If sufficient information is available design equations can be built from this analysis procedure. The AASHTO pavement design procedure was developed using regression techniques such as the one described above. Regression techniques are appropriate only when mechanistic procedures are not available or when the variable is so complex that the true mechanisms are not fully known. The quality of the final model depends on the availability of the crucial performance related factors. For example, factors which are known to influence CRCP performance are the maximum temperature drop in the early life of the concrete and the frequency and magnitude of gross overloads. Neither of these are available for this study. Nevertheless regression techniques can give valuable insights into the factors that play a dominant role in CRCP deterioration.

In the analysis presented below the variable of interest is the Failures per Mile. This is the structural variable of prime interest to highway department personnel. The data from section 01001 EB in District 1 is plotted below in Figure 18.

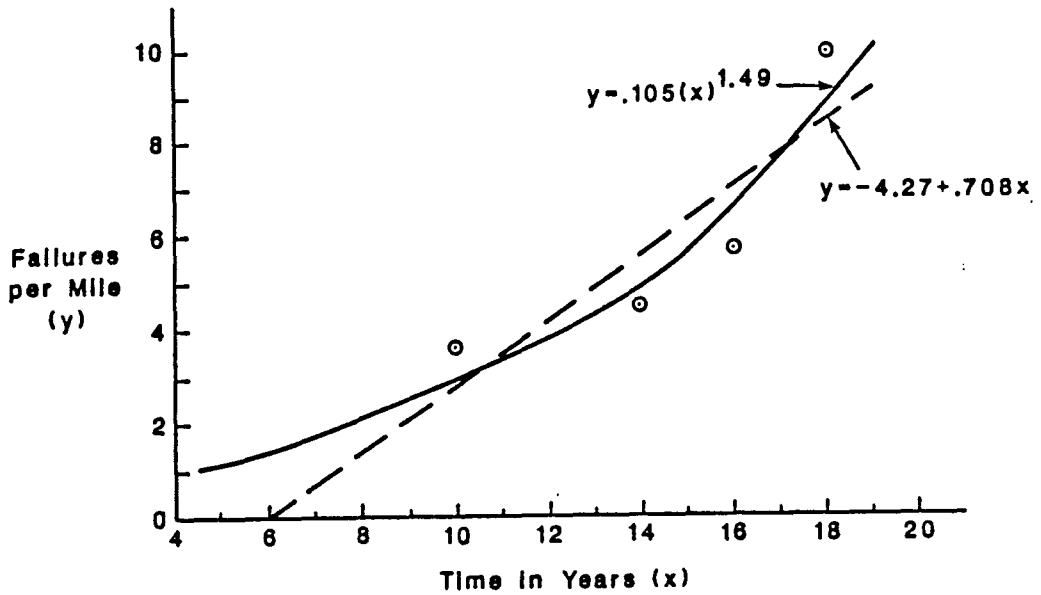

Figure 18. Failures data from Section 01001 District 1

Figure 18 also illustrates the least-squares regression lines used to fit the data. Equations for both the linear and power model are shown. The power model best fits the data; the rate of growth of failures increases as the pavement gets closer to failure. The linear model underpredicts the growth rate near pavement failure; however, it is easier to understand and is simpler to build linear regression models. Both linear and power parameters have been generated to define the rate of failure growth in all 24 sections. The linear model results are tabulated in Figure 19. This is an important figure which summarizes the information on project level CRCP performance. The columns in this figure are defined as follows:

(1) CFTR No. Section Identification Number on the detailed data sheets in Appendix B.

(2) IH IH = 1 means the section is located on an Interstate pavement.

Figure 19 Project Level Performance Data

CFTR No.	IH	DIST.	COUNTY	C.NO.	DESIGN CAT	DESIGN BT	CLIMATE RAIN	CLIMATE FTC	CLIMATE TI	TRAFFIC M.KIPS/YR	TRAFFIC ADT(1986)	PERFORMANCE FMY	PERFORMANCE TFF	PERFORMANCE RGF	PERFORMANCE TOR	PERFORMANCE FAR	PERFORMANCE SMY
01001EB	1	1	HOPKINS	113	1	2	46.1	39.9	67.2	0.87	8050	0.36	7.4	0.71	20	9.9	0.27
01003EB	1	1	HOPKINS	113	1	3	46.1	39.9	67.2	0.89	6400	0.22	10.7	0.38	18	3.9	0.31
01005EB	1	1	FRANKLIN	81	1	3	45.8	39.0	46.1	0.90	6500	0.24	11.0	0.42	20	4.8	0.42
01008NB	0	1	GRAYSON	92	1	4	38.1	35.0	46.3	0.64	8300	0.33	8.5	0.60	18	6.7	0.68
01012NB	0	1	LAMAR	139	3	1	47.2	38.1	47.9	0.50	5500	0.62	7.8	0.98	13+	-	6.77
01015WB	0	1	GRAYSON	92	-	1	38.1	35.0	46.3	0.17	3750	0.22	6.5	0.35	10+	-	0.28
04002WB	1	4	POTTER	118	3	4	19.8	81.1	-17.6	1.07	33000	0.00	-	-	19	-	0.07
04005WB	1	4	CARSON	33	2	1	20.2	82.5	-18.7	0.59	4300	0.34	12.0	1.15	18	6.6	0.21
04006WB	1	4	CARSON	33	2	1	20.2	82.5	-18.7	0.58	4175	0.14	11.6	0.18	22	3.0	0.10
04010WB	1	4	POTTER	188	3	1	19.8	81.1	-17.6	0.72	6025	0.14	12.7	0.32	17	2.4	0.42
04011WB	1	4	POTTER	188	3	1	19.8	81.1	-17.6	0.72	5025	0.31	5.4	0.38	16+	-	0.55
04012WB	1	4	CARSON	33	3	1	20.2	82.5	-18.7	0.61	4600	0.13	13.6	0.24	17	1.9	0.44
0004WB	1	20	JEFFERSON	124	-	-	53.8	8.0	31.4	0.69	12225	0.28	-	-	11	-	-
0009EB	1	20	JEFFERSON	124	-	-	53.8	8.0	31.4	0.71	11500	1.37	9.6	3.08	17	23.6	0.21
0015SB	0	20	LIBERTY	146	2	3	58.3	13.3	30.5	0.76	9425	5.75	12.1	12.03	21+	10.72	13.3
0018EB	0	20	JEFFERSON	124	2	3	53.8	8.0	31.4	0.12	4425	0.40	12.1	1.42	23	14.4	24.1
0021EB	0	20	JEFFERSON	124	2	3	53.8	8.0	31.4	0.12	2950	0.30	9.9	0.92	20	10.3	17.7
0023SB	0	20	JEFFERSON	124	2	3	53.8	8.0	31.4	0.47	21500	0.83	5.1	0.94	15+	-	1.1
4004WB	1	24	EL PASO	72	1	2	8.1	66.4	-46.6	0.99	67500	0.00	-	-	24+	-	0.04
4009EB	1	24	CULBERSON	55	1	2	8.1	66.4	-44.1	0.72	3950	0.03	-	-	15+	-	0.16
4010WB	1	24	JEFF DAVIS	123	1	2	19.1	44.4	-11.6	0.72	3950	0.02	-	-	17+	-	0.18
4011WB	1	24	CULBERSON	55	1	2	10.2	59.7	-44.1	0.74	3950	0.02	-	-	17+	-	0.41
4014EB	1	24	CULBERSON	55	-	-	10.2	59.7	-44.1	0.78	4000	0.02	-	-	16+	-	0.48
4022WB	1	24	CULBERSON	55	-	-	10.2	59.7	-44.1	0.79	3800	0.04	-	-	12+	-	0.28

Figure 19 Project Level Performance Data

(Continued)

Key

CAT Coarse Aggregate Type 1= Crushed Limestone 2 = Sil. River Gravel 3 = Combined 1 and 2

BT Base Type 1= HMA 2= Unstabilized 3 = Soil Cement 4 = Lime Stabilized

FTC = Air Freeze Thaw Cycles

FMY = Failures per mile per year

RGF = Linear Rate Growth Failures

FAR = Number Failures per mile at Rehabilitation

TI = Thornthwaite Index

TFF = Time to first failure (years)

TOR = Time until Rehabilitation (years)

SMY = Severe Spalled Cracks per mile per year

(3) DIST. The Texas District Number

(4) COUNTY The Texas County Name

(5) C.No. The Texas County Number

(6) CAT Coarse Aggregate Type

1 = Crushed Limestone

2 = Siliceous River Gravel

3 = Combined 1 and 2

(7) BT Base Type

1 = Asphalt Hot Mix

2 = Unstabilized Base

3 = Soil Cement

4 = Lime Stabilized

(8) RAIN The Rainfall in inches per year

(9) FTC The Air Freeze Thaw Cycles in cycles per year

(10) TI The Thornthwaite Index, a measure of moisture balance with large positive values indicating an excess.

(11) M.KIPS/YR The estimated annual 18 kips ESAL in millions. Calculated by dividing the total accumulative 18 kip ESAL since construction by the number of years since construction.

(12) ADT The Average Daily Traffic for 1986, two directions.

(13) FMY The number of Failures per Mile per Year. The total number of failures (Punchouts + PCC patches + HMA patches) prior to rehabilitation divided by the section length and the number of years since construction.

(14) TFF The Number of years until the First Failure occurred in the pavement, obtained from the linear model shown in

Figure 18.

(15) RGF The Rate of Growth of Failures, obtained from the linear model shown in Figure 18.

(16) TOR The Time until major Rehabilitation , in years

(17) FAR The Failures At Rehabilitation, the number of failures per mile in the pavement at the time rehabilitation was undertaken.

(18) SMY The Spalling per Mile per Year. The total number of severely spalled cracks in the section prior to rehabilitation divided by the section length and the number of years since construction.

Data Analysis

The purpose of this study is to determine the performance of CRCP in Texas. Many different types of analysis could be undertaken on the data presented in Table 19 and in Appendix B. However it is proposed to limit the analysis to the following:

(1) Identification of the factors most significant in the development of the two critical distress types, failures and severe spalling.

(2) Calculating the average time until major rehabilitation is required in each district.

(3) Calculate the typical pavement repair costs once rehabilitation is required.

Most significant factors influencing performance. In section 3 of this report the results of other studies were presented. Figures 12 and 13 showed the effect of both coarse aggregate type and rainfall on CRCP performance. The results of this study confirm these findings,

Figures 20 and 21 contain a summary of data from Figure 19. These figures illustrate that both rainfall and coarse aggregate type have a significant impact on CRCP performance.

District	Rainfall ins/year	Failures/Mile Year	Spalling/Mile/ Year
1	43.5	0.33	1.45
4	20.0	0.18	0.30
20	54.5	1.48	11.30
24	10.9	0.03	0.26

Figure 20 Effect of Rainfall on the average growth in Pavement distress.

Coarse Aggregate Type	Coefficient of Expansion in/in/^{o}F X10^{-6}	Failures/Mile/ Year	Spalling/Mile/ Year
Limestone	3.8	0.24	0.30
River Gravel	6.0	1.29	9.31
Limestone/ River Gravel	4.9 (assumed)	0.24	1.64

Figure 21 Effect of Coarse Aggregate type on the average growth of pavement distress.

The coefficient of linear expansion for PCC as a function of aggregate type has been added to Figure 21. This factor is used in the new AASHTO Design Guide (3) for designing the percent of reinforcing steel however it is not currently used in designing overall slab thickness.

To evaluate which of the readily available factors, the

coefficient of linear expansion (COLE) of PCC, rainfall (RAIN) or 18 kip ESAL's (KIPS), most influence pavement deterioration rate a stepwise regression analysis was performed. The two dependent variables the Rate of Growth of Failures (RGF) and Spalling/Mile/Year (SMY) were regressed against the 3 factors. Both linear and logarithmic models were built, the models with the best R-squared values are shown below.

Failure Model

$$RGF = 10^{-5.23}\ COLE^{3.61}\ RAIN^{1.78}\ KIPS^{0.704} \qquad R^2 = 0.65$$

where RGF = Rate of growth of failures (Range 0.1 to 1.5)

COLE = Coefficient of expansion of PCC x 10^6 (Range 3.8 to 6.0)

RAIN = Rainfall in inches (Range 19 to 58)

KIPS = Annual 18-kip ESAL in millions (Range 0.12 to 0.90)

Severe Spalling Model

$$SMY = 10^{-4.4}\ COLE^{2.69}\ RAIN^{1.67} \qquad R^2 = 0.57$$

where SMY = Severely spalled cracks per mile per year (Range 0 to 17.0)

In both models the logarithmic equation fit the data better than the linear equation. The most significant variable in the failure model was rainfall (F-statistic = 14.6), followed by expansion factor (F = 8.35), followed by traffic loadings (F = 3.2). Broadly speaking the F-Statistic is a measure of the importance of that variable to the

model. In the spalling model the KIP variable was found to be insignificant, the rainfall and expansion F values were 11.1 and 2.7 respectively.

The conclusion of this analysis is that of the three variable studied the one with the most impact on pavement performance was rainfall followed by coefficient of PCC expansion (related to coarse aggregate type) followed by traffic loadings. The traffic loadings had no influence on spalling and only a minor influence on growth of failures. The R-Squared of these models could be improved if other key variables were included. Although important, variable such as subbase friction, occurrence of gross overloads and temperature variations in the early life of the concrete are frequently not available.

Calculation of average time until major rehabilitation. Excluding the sections in Figure 19 which have not been rehabilitated the average time till major rehabilitation is tabulated below:

Climate	Average time till Rehabilitation (Years)
Wet/Freeze Thaw	19.0
Dry/Freeze Thaw	18.6
Wet/No Freeze	17.7
Dry/No Freeze	Not available

Figure 22 Time till Rehabilitation

Although the pavement distress types have been shown to depend strongly on environmental factors, the time at which major

rehabilitation occurs is relatively constant. In the mild climate (Dry/No Freeze) none of the six section had received any major rehabilitation.

Rehabilitation Costs. The rehabilitation cost data from Appendix B is summarized below in Figure 23. The cost figures are for a one mile length of one side of a divided highway (2 lanes).

Rehabilitation Cost $/mile	Section Length (miles)	ADT	Failures per mile at Rehabilitation
150,223	9.3	12225	-
746,305*	-	11500	23.6
203,612	6.0	8050	9.9
221,192	6.1	6400	3.9
213,385	5.4	6500	4.8
333,383	9.0	8300	6.7
265,018	1.3	33000	0.0
373,673*	4.2	6025	2.4
94,355	2.2	4600	1.9

Figure 23 Summary Rehabilitation Cost Data.

(* indicates two jobs less than two years apart)

All of these cost figures are for jobs completed after 1982.

VI CONCLUSION

This has been a study of the performance of CRCP in Texas. All pavements were eight inches thick and built between 1960 and 1972. The major findings of this study are as follows:

1. The pavements constructed in the mild environmental zone (Dry/No Freeze) are performing significantly better than those in the other three zones.
2. In the other three zones major rehabilitation costs have been incurred around year 18. These costs include repairing several pavement failures, typically punchouts, and placing a thick HMA overlay on the section.
3. The rate at which failures occur in the CRCP was related mainly to rainfall and aggregate type and to a lesser extent to accumulative traffic loadings.
4. Severe spalling was related to rainfall and aggregate type. Traffic loadings were found to have no significant effect.
5. Studies of this type are required to provide objective information for life cycle costing. Additional studies on CRCP are required to (a) evaluate the performance of thicker slabs and (b) evaluate the performance in harsher environments such as hard freeze zones. Similar studies should also be undertaken on other pavement types.

VII REFERENCES

1. Mitchell, M.F., Walker, R. N., The Economics of Pavement Type Selection", Third International Conference on Concrete Pavement Design and Rehabilitation, Purdue University, April 23-25, 1985.

2. Saraf, C. L., McCullough, B.F., and Hudson, W. R., "Condition Survey and Pavement Evaluation of Existing and Overlaid Rigid Pavements" Report 388-5F, Center for Transportation Research, The University of Texas, Austin November, 1985.

3. "AASHTO Guide for Design of Pavement Structures" Chapter 3, Published by AASHTO, 1986.

4. Saraf, C. L., Torres-Verdin, V. and McCullough, B. F. "Manual for Condition Survey of Continuously Reinforced Concrete Pavements and Jointed Concrete Pavements" Research Report 388-3, Center for Transportation Research, The University of Texas, Austin, May 1985.

5. "Failure and Repair of Continuously Reinforced Concrete Pavement" NCHRP Synthesis 60, July 1979.

6. Lacoursiere, S.A., Darter, M. I., and Smiley, S. A., "Performance of Continuously Reinforced Concrete Pavement in Illinois," U of Illinois, Transp. Engineering Series 20, No. 172 (Dec. 1978)

7. Machado, J. P. "Continuously Reinforced Concrete Pavement: Prediction of Distress Quantities", Master of Science Thesis, University of Texas at Austin, May, 1977.

8. Ref. 7 Page 56

9. Torres-Verdin, V., McCullough, B. F. and Peck, G. B. "The Effect of Coarse - Aggregate Type on CRCP Thickness" Research Report 249-7, Center for Transportation Research, University of Texas in Austin, Nov. 1983.

10. Ref. 9 Page 62

11. Gutierrez de Velasco, M., and McCullough, B. F., "Summary Report for 1978 CRCP condition survey in Texas" Research Report 177-20, Center for Transportation Research, The University of Texas at Austin, January 1981.

12. Saraf, C. L., Chou, C, and McCullough, B. F. "The Effect of Rainfall on the Performance of CRC Pavement in Texas." TRB paper, January 1987.

13. Darter, M. I., Becker, J. M., Snyder, M. B., Smith, R. E., "Portland Cement Concrete Pavement Evaluation System Copes" NCHRP 227, September 1985.

Appendix A

NETWORK LEVEL DETAILED PERFORMANCE DATA

DISTRICT 20

BEAUMONT, TEXAS

DISTRICT 20

Figure A1. CRCP Performance in District 20

(Miles surviving without overlays)

Section #	6	7	8	9	10	11	12	13	14	15
0002 NB 1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	9.0	6.2
0005 NB 2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	8.7	5.8
0006 NB 1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	14.4	14.2
0012 NB 1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	14.1	13.8
0022 NB 1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	-	-
0023 NB 2.4	2.4	2.4	2.4	2.4	2.4	2.4	-	-	-	-
0025 SB 1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
0005 SB 1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
0006 SB 1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
0011 SB 3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
0012 SB 1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
0013 SB 0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
0014 SB 3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
0015 SB 3.2	3.2	3.1	3.0	2.9	2.8	2.7	2.6	2.6	2.6	2.5
0016 SB 0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
0022 SB 1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	-	-
0023 SB 2.4	2.4	2.4	2.4	2.4	2.4	2.4	-	-	-	-
0004 EB 9.6	9.6	9.6	9.6	9.6	9.6	9.6	6.7	4.6	2.5	0.4
0009 EB 8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	-
0017 EB 1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-
0018 EB 3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
0021 EB 5.0	5.0	4.8	4.7	4.6	4.6	4.6	4.6	4.6	-	-
0026 EB 1.2	1.2	1.2	1.2	1.2	1.2	-	-	-	-	-
0001 WB 0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
0003 WB 4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
0004 WB 9.6	9.6	9.6	9.6	9.6	9.6	9.6	6.7	4.6	2.5	0.4
0009 WB 8.2	8.2	8.2	8.2	8.2	8.2	7.8	7.4	7.0	6.6	6.1
0019 WB 2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
0020 WB 1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
0026 WB 0.8	0.8	0.8	0.8	0.8	0.8	-	-	-	-	-
TOTAL MILES	86.0	86.0	86.0	86.0	86.0	84.0	79.2	79.2	71.4	71.4
TOTAL MILES NOT OVERLAYED	86.0	85.7	85.5	85.3	85.2	82.7	71.6	67.0	55.0	50.2
% SURVIVING	100%	100%	99%	99%	99%	98%	90%	85%	77%	70%

DISTRICT 20

Figure A1 CRCP Performance in District 20

(Miles surviving without overlays)

Section #	16	17	18	19	20	21	22	23	24	25
0002 NB 1.6	1.6	1.6	1.6	1.6	-	-	-			
0005 NB 2.2	2.2	2.2	2.2	2.2	-	-	-			
0006 NB 1.1	1.1	1.1	1.1	-	-	-	-			
0012 NB 1.1	1.2	1.2	-	-	-	-	-			
0022 NB 1.4	-	-	-	-	-	-	-			
0023 NB 2.4	-	-	-	-	-	-	-			
0025 SB 1.8	1.8	1.8	1.8	1.8	-	-	-			
0005 SB 1.8	1.8	1.8	1.8	1.8	-	-	-			
0006 SB 1.1	1.1	1.1	1.1	-	-	-	-			
0011 SB 3.4	3.4	3.4	-	-	-	-	-			
0012 SB 1.2	1.2	1.2	-	-	-	-	-			
0013 SB 0.6	0.6	0.6	-	-	-	-	-			
0014 SB 3.1	3.1	3.1	-	-	-	-	-			
0015 SB 3.2	2.4	2.4	2.4	-	-	-	-			
0016 SB 0.8	0.8	-	-	-	-	-	-			
0022 SB 1.4	-	-	-	-	-	-	-			
0023 SB 2.4	-	-	-	-	-	-	-			
0004 EB 9.6	0.4	0.4	0.4	0.4	-	-	-			
0009 EB 8.2	8.2	4.1	0.0	0.0	0.0	0.0	0.0			
0017 EB 1.0	-	-	-	-	-	-	-			
0018 EB 3.0	-	-	-	-	-	-	-			
0021 EB 5.0	-	-	-	-	-	-	-			
0026 EB 1.2	-	-	-	-	-	-	-			
0001 WB 0.7	0.7	0.7	0.7	0.7	-	-	-			
0003 WB 4.2	4.2	4.2	4.2	4.2	-	-	-			
0004 WB 9.6	0.4	0.4	0.2	0.0	0.0	0.0	0.0			
0009 WB 8.2	5.6	2.8	0.0	0.0	0.0	0.0	0.0			
0019 WB 2.6	2.1	1.6	-	-	-	-	-			
0020 WB 1.2	1.2	1.2	-	-	-	-	-			
0026 WB 0.8	-	-	-	-	-	-	-			
TOTAL MILES	67.4	66.6	53.7	47.9	26.0	26.0	26.0			
TOTAL MILES NOT OVERLAYED	45.1	36.9	17.5	12.7	0.0	0.0	0.0			
% SURVIVING	67%	55%	33%	27%	0%	0%	0%	-	-	-

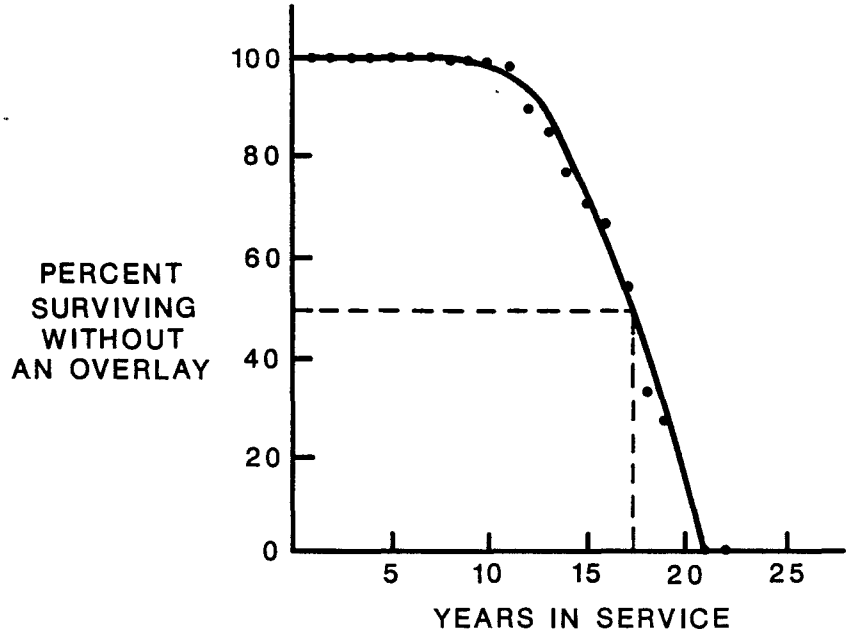

Figure A2. Survivor Curve for CRCP in District 20 (Beaumont, Texas)

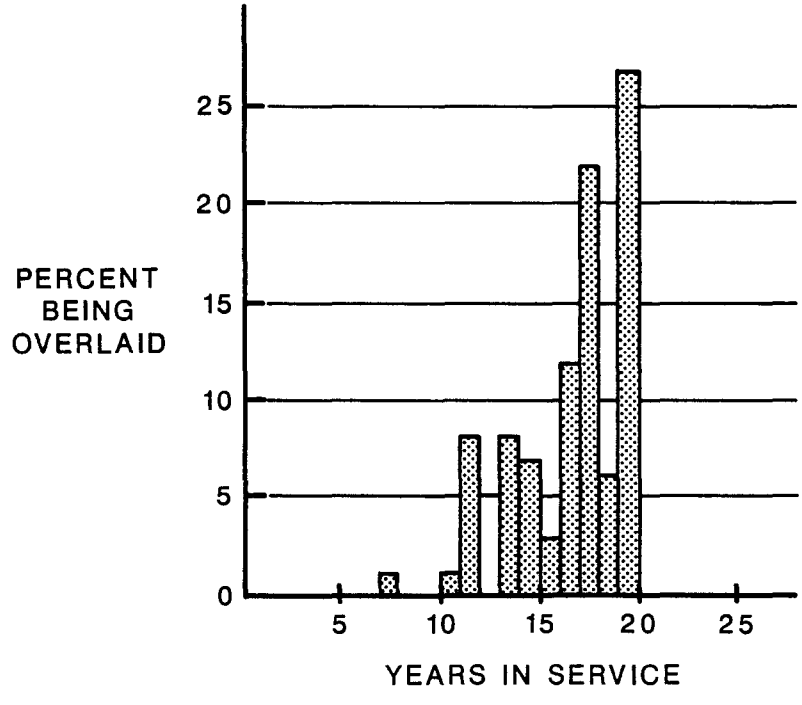

Figure A3. Percentage of CRCP overlaid each year of service

Figure A4 Failure Summary Chart

(District 20)

ID	Section Length	Failures/Mile/Year F/M/Y	Failures/Section/Year F/S/Y
0002 NB	1.6	0.03	0.05
0005 NB	2.2	0.09	0.21
0006 NB	1.1	0.17	0.19
0012 NB	1.2	0.17	0.20
0022 NB	1.4	0.05	0.08
0023 NB	2.4	0.07	0.18
0002 SB	1.8	0.10	0.18
0005 SB	1.8	0.23	0.42
0006 SB	1.1	0.20	0.22
0011 SB	3.4	0.26	0.90
0012 SB	1.2	0.10	0.12
0014 SB	3.2	0.42	1.33
0015 SB	2.4	5.75	13.8
0016 SB	0.8	1.48	1.19
0022 SB	1.4	0.93	1.30
0023 SB	2.4	0.83	2.0
0004 EB	8.2	1.40	11.54
0009 EB	8.2	1.37	11.25
0017 EB	1.0	1.0	1.0
0018 EB	3.0	0.40	1.2
0021 EB	4.6	0.30	1.39
0026 EB	1.2	1.33	1.60
0001 WB	0.7	1.73	1.21
0003 WB	4.2	0.33	1.37
0004 WB	9.4	0.28	2.63
0009 WB	6.6	2.00	13.21
0019 WB	2.4	0.37	0.88
0020 WB	1.2	0.73	0.88
0026 WB	0.8	2.25	1.80
Totals	80.9		72.3

DISTRICT 1

PARIS, TEXAS

DISTRICT 1

Figure A5 Miles Surviving without Overlay

(District 1)

Section #	Age 6	7	8	9	10	11	12	13	14	15
1001 EB 6.3	6.4	6.4	6.4	6.4	6.4	6.3	6.2	6.1	6.0	6.0
1001 EB 6.4	6.4	6.4	6.3	6.2	6.1	6.1	6.0	5.9	5.8	5.8
1002 EB 1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
1002 WB 1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
1003 EB 6.4	6.4	6.4	6.4	6.4	6.3	6.2	6.1	6.0	6.0	6.0
1003 WB 6.4	6.4	6.4	6.4	6.4	6.4	6.3	6.3	6.2	6.2	6.2
1004 EB 5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
1004 WB 5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
1005 EB 5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
1005 WB 5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
1008 NB 9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.1	8.6
1008 SB 9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
1011 NB 0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	-	-
1012 NB 2.0	2.0	2.0	2.0	2.0	1.9	1.8	1.7	1.6	-	-
1013 NB 10.0	10.0	10.0	10.0	10.0	9.8	9.6	8.8	8.0	-	-
1013 nb 2.4	2.4	2.4	2.4	2.4	2.0	1.6	1.4	1.2	-	-
1015 EB 3.2	3.2	3.2	3.2	3.2	-	-	-	-	-	-
1015 WB 3.6	3.6	3.6	3.6	3.6	-	-	-	-		-
TOTAL MILES	91.4	91.4	91.4	91.4	84.6	84.6	84.6	84.6	69.6	69.6
TOTAL MILES NOT OVERLAYED	91.4	91.4	91.3	91.2	83.5	82.5	81.1	79.6	67.5	67.0
% SURVIVING	100%	100%	100%	100%	99%	97%	96%	94%	97%	97%

DISTRICT 1

Figure A5 Miles Surviving without Overlay

(District 1)

Section #	Age 16	17	18	19	20	21	22	23	24	25
1001 EB 6.3	6.0	5.8	5.6	4.4	3.2	-	-	-	-	-
1001 EB 6.4	5.8	5.2	4.6	3.9	3.2	-	-	-	-	-
1002 EB 1.6	1.6	1.6	1.6	1.2	0.8	-	-	-	-	-
1002 WB 1.6	1.6	1.6	1.6	1.0	0.4	-	-	-	-	-
1003 EB 6.4	5.9	5.8	4.1	2.4	-	-	-	-	-	-
1003 WB 6.4	5.1	4.0	3.2	2.4	-	-	-	-	-	-
1004 EB 5.6	5.6	5.6	-	-	-	-	-	-	-	-
1004 WB 5.6	5.6	5.6	-	-	-	-	-	-	-	-
1005 EB 5.4	5.4	5.4	-	-	-	-	-	-	-	-
1005 WB 5.4	5.4	5.4	-	-	-	-	-	-	-	-
1008 NB 9.6	8.5	8.4	-	-	-	-	-	-	-	-
1008 SB 9.2	8.0	8.0	-	-	-	-	-	-	-	-
1011 NB 0.6	-	-	-	-	-	-	-	-	-	-
1012 NB 2.0	-	-	-	-	-	-	-	-	-	-
1013 NB 10.0	-	-	-	-	-	-	-	-	-	-
1013 NB 2.4	-	-	-	-	-	-	-	-	-	-
1015 EB 3.2	-	-	-	-	-	-	-	-	-	-
1015 WB 3.6	-	-	-	-	-	-	-	-		-
TOTAL MILES	69.6	69.6	28.8	28.8	16.0	-	-	-	-	-
TOTAL MILES NOT OVERLAYED	65.1	62.4	20.7	15.3	7.6	-	-	-	-	-
% SURVIVING	94%	90%	72%	53%	48%	-	-	-	-	-

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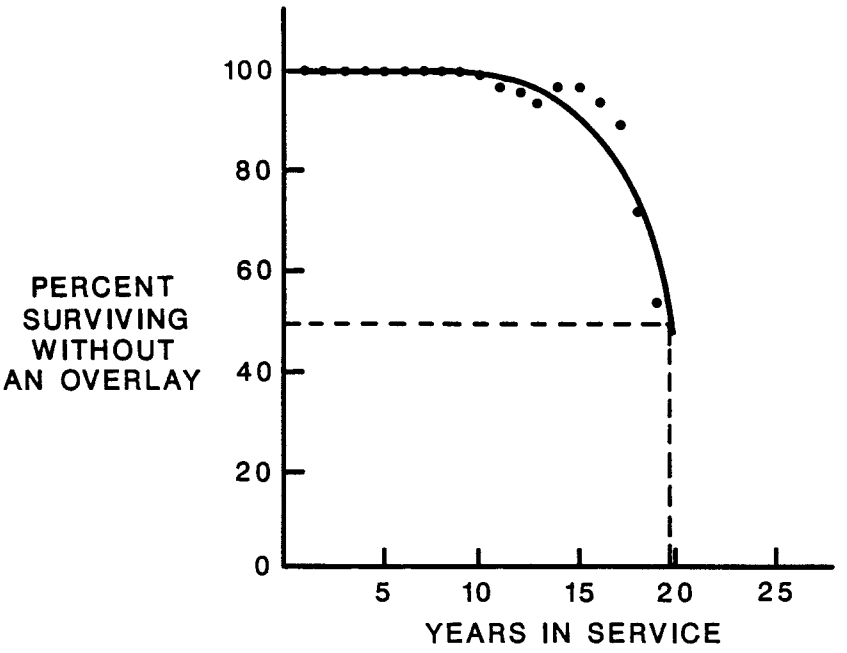

Figure A6. Survivor Curve for CRCP in District 1 (Paris, Texas)

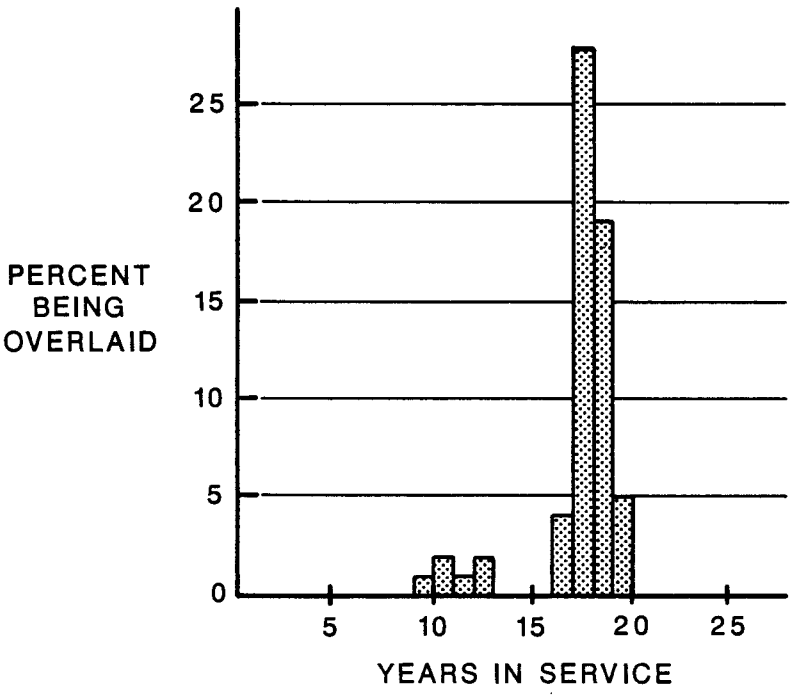

Figure A7. Percentage of CRCP overlaid each year of service

Figure A8 Failure Summary Chart

(District 1)

ID	Section Length	Failures/Mile/Year F/M/Y	Failures/Section/Year F/S/Y
1001 EB	6.0	0.36	2.18
1001 WB	5.8	0.14	0.81
1002 EB	2.0	0.50	1.00
1002 WB	2.0	0.62	1.25
1003 EB	6.0	0.18	1.06
1003 WB	6.4	0.29	1.87
1004 EB	5.6	0.25	1.41
1004 WB	5.6	0.19	1.06
1005 EB	5.4	0.24	1.29
1005 WB	5.6	0.30	1.71
1008 NB	9.2	0.30	2.76
1008 SB	9.4	0.99	9.30
1012 NB	2.0	0.50	1.00
1013 NB	8.0	0.93	7.46
1013 SB	2.2	0.25	0.55
1015 WB	3.6	0.10	0.37
TOTALS	84.8		35.08

DISTRICT 4

AMARILLO, TEXAS

DISTRICT 4

Figure A9 Miles Surviving without Overlay

(District 4)

Section #	Age 6	7	8	9	10	11	12	13	14	15
4006 WB 5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
4006 EB 5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
4005 WB 7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
4005 EB 8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
4004 EB 2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
4004 WB 2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
4002 WB 2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
4002 EB 2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
4010 WB 4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.3
4010 EB 4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.3
4007 EB 5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
4007 WB 6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
4003 EB 1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
4003 WB 1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
4009 WB 4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
4009 EB 4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
4011 WB 7.4	7.4	7.4	7.4	7.4	7.4	7.1	6.8	-	-	-
4011 EB 7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	-	-	-
4008 EB 0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
4008 WB 1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
4012 WB 2.6	2.6	2.6	2.6	2.6	-	-	-	-	-	-
4012 EB 2.5	2.5	2.5	1.8	1.2	-	-	-	-	-	-
TOTAL MILES	91.7	91.7	91.7	91.7	86.6	86.3	86.0	71.6	71.6	71.6
TOTAL MILES NOT OVERLAYED	91.7	91.7	91.0	90.4	86.6	86.3	86.0	71.6	71.6	71.0
% SURVIVING	100%	100%	99%	99%	100%	100%	99%	100%	100%	99%

DISTRICT 4

Figure A9 Miles Surviving without Overlay

(District 4)

Section #	Age 16	17	18	19	20	21	22	23	24	25
4006 WB 5.9	5.9	5.2	4.4	-	-	-	-	-	-	-
4006 EB 5.6	5.6	4.6	3.6	-	-	-	-	-	-	-
4005 WB 7.8	7.8	5.9	4.0	-	-	-	-	-	-	-
4005 EB 8.3	8.3	6.1	4.0	-	-	-	-	-	-	-
4004 EB 2.0	2.0	2.0	2.0	-	-	-	-	-	-	-
4004 WB 2.0	2.0	1.8	1.6	-	-	-	-	-	-	-
4002 WB 2.4	2.4	2.4	2.4	1.4	0.4	-	-	-	-	-
4002 EB 2.4	2.4	2.4	2.4	1.2	0.0	0.0	0.0	0.0	0.0	0.0
4010 WB 4.6	4.0	-	-	-	-	-	-	-	-	-
4010 EB 4.6	4.0	-	-	-	-	-	-	-	-	-
4007 EB 5.8	5.8	2.9	0.0	0 .0	0.0	0.0	0.0	0.0	0.0	0.0
4007 WB 6.4	6.4	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4003 EB 1.4	1.4	1.4	-	-	-	-	-	-	-	-
4003 WB 1.4	1.4	1.4	-	-	-	-	-	-	-	-
4009 WB 4.4	4.4	-	-	-	-	-	-	-	-	-
4009 EB 4.8	4.8	-	-	-	-	-	-	-	-	-
4011 WB 7.4	-	-	-	-	-	-	-	-	-	-
4011 EB 7.6	-	-	-	-	-	-	-	-	-	-
4008 EB 0.8	0.8	-	-	-	-	-	-	-	-	-
4008 WB 1.0	1.0	-	-	-	-	-	-	-	-	-
4012 WB 2.6	-	-	-	-	-	-	-	-	-	-
4012 EB 2.5	-	-	-	-	-	-	-	-	-	-
TOTAL MILES	71.6	50.0	47.2	17.0	17.0	-	-	-	-	-
TOTAL MILES NOT OVERLAYED	70.4	39.3	24.4	2.6	0.4	-	-	-	-	-
% SURVIVING	98%	79%	52%	15%	2%	0%	0%	0%	0%	0%

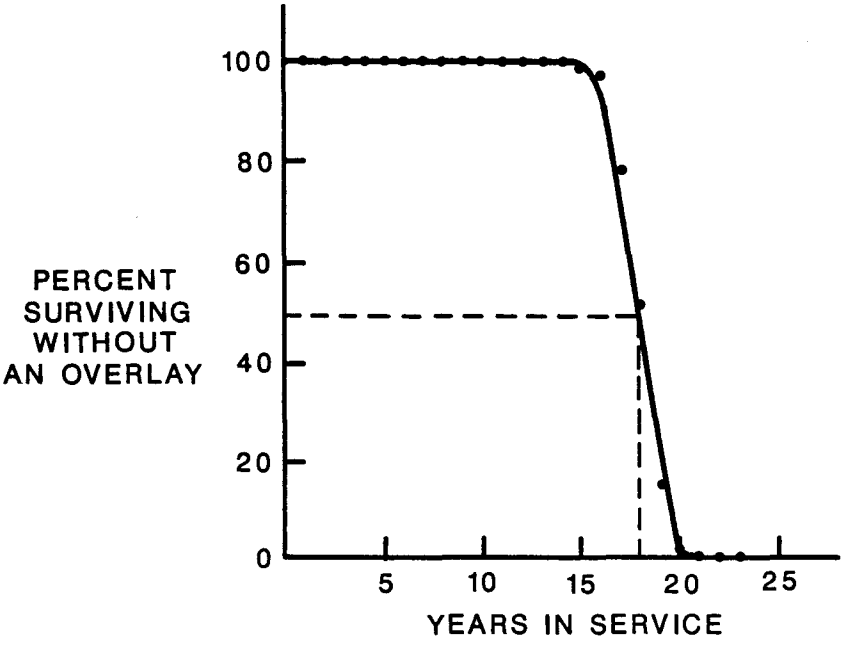

Figure A10. Survivor Curve for CRCP in District 4 (Amarillo, Texas)

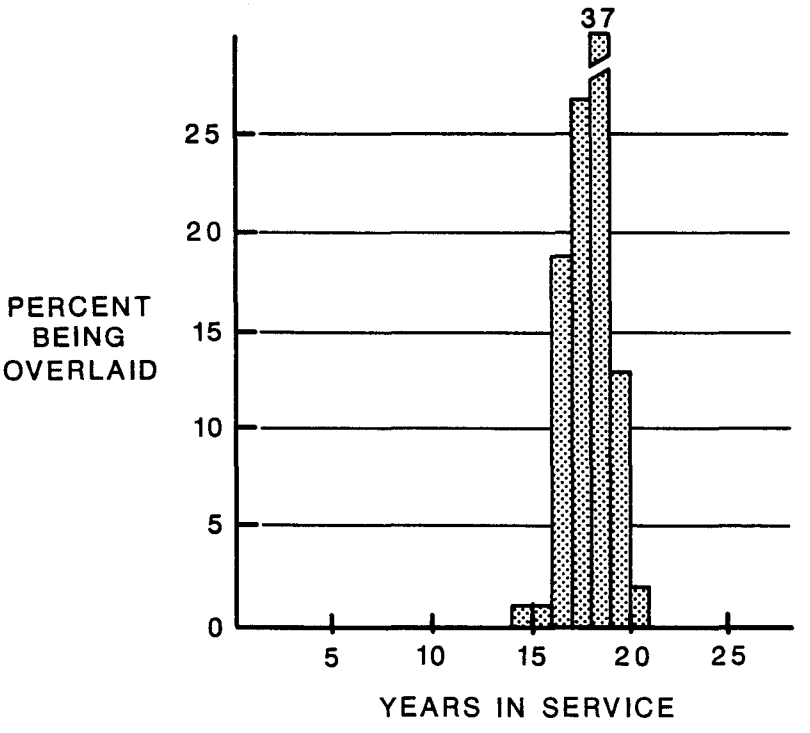

Figure A11. Percentage of CRCP overlaid each year of service

Figure A12 Failure Summary Chart

(District 4)

ID	Section Length	Failures/Mile/Year F/M/Y	Failures/Section/Year F/S/Y
4006 WB	6.0	0.13	0.81
4006 EB	5.6	0.17	0.93
4005 WB	7.8	0.34	2.69
4005 EB	8.3	0.38	3.12
4004 EB	2.0	0.14	0.28
4002 EB	2.4	0.16	0.38
4010 WB	4.4	0.12	0.56
4010 EB	4.4	0.14	0.62
4007 EB	5.8	0.57	3.31
4007 WB	6.4	0.34	2.19
4003 EB	1.2	0.30	0.36
4003 WB	1.6	0.23	0.37
4009 EB	4.4	0.26	0.25
4009 EB	4.8	0.04	0.19
4011 WB	6.8	0.31	2.08
4011 EB	8.0	0.26	2.08
4012 WB	2.4	0.23	0.56
4012 EB	2.4	0.42	1.0
TOTALS	84.7		21.78

DISTRICT 24

EL PASO, TEXAS

DISTRICT 24

Figure A13 Miles Surviving without Overlay

(District 24)

Section #	Age 6	7	8	9	10	11	12	13	14	15
4022 EB 4.0	4.0	4.0	4.0	4.0	-	-	-	-	-	-
4020 EB 11.2	11.2	11.2	11.1	11.2	11.2	-	-	-	-	-
4015 EB 0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	-	-
4014 EB 12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	-	-
4012 EB 1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.0	0.8	-
4011 EB 10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	9.8	9.6	-
4009 EB 2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.6	2.4
4010 EB 6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.4	6.0
4010 WB 7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	6.0	4.8
4009 WB 2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.6	2.4
4011 WB 9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.4	9.2	-
4012 WB 1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.0	0.8	-
4014 WB 12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	-	-
4015 WB 0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	-	-
4020 WB 11.6	11.6	11.6	11.6	11.6	11.6	-	-	-	-	-
4023 WB 1.2	1.2	1.2	1.2	1.2	-	-	-	-	-	-
4022 WB 2.4	2.4	2.4	2.4	2.4	-	-	-	-	-	-
TOTAL MILES	96.8	96.8	96.8	96.8	89.2	66.4	66.4	66.4	45.2	19.6
TOTAL MILES NOT OVERLAYED	96.8	96.8	96.8	96.8	89.2	66.4	66.4	65.6	38.0	15.6
% SURVIVING	100%	100%	100%	100%	100%	100%	100%	99%	84%	80%

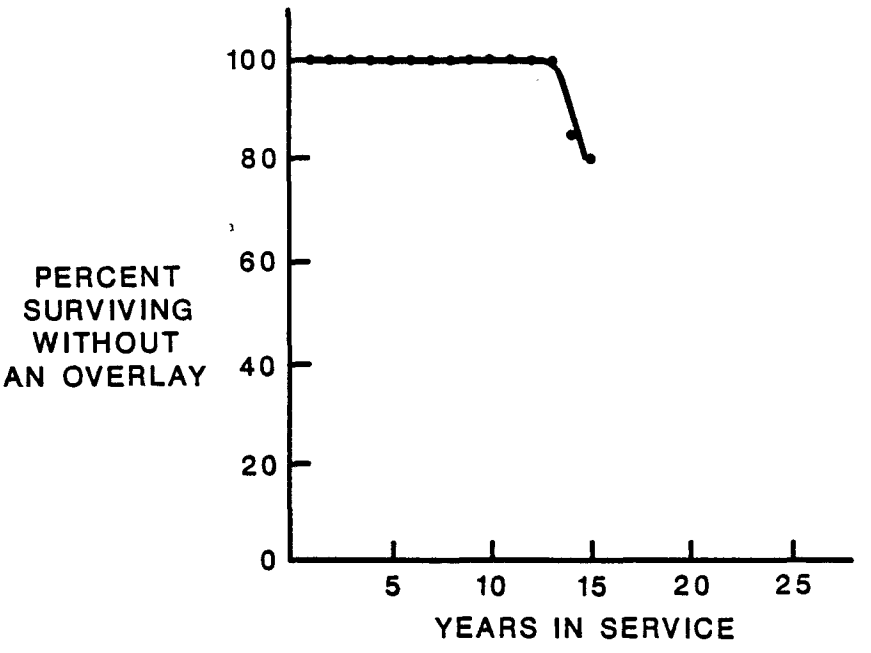

Figure A14. Survivor Curve for CRCP in District 24 (El Paso, Texas)

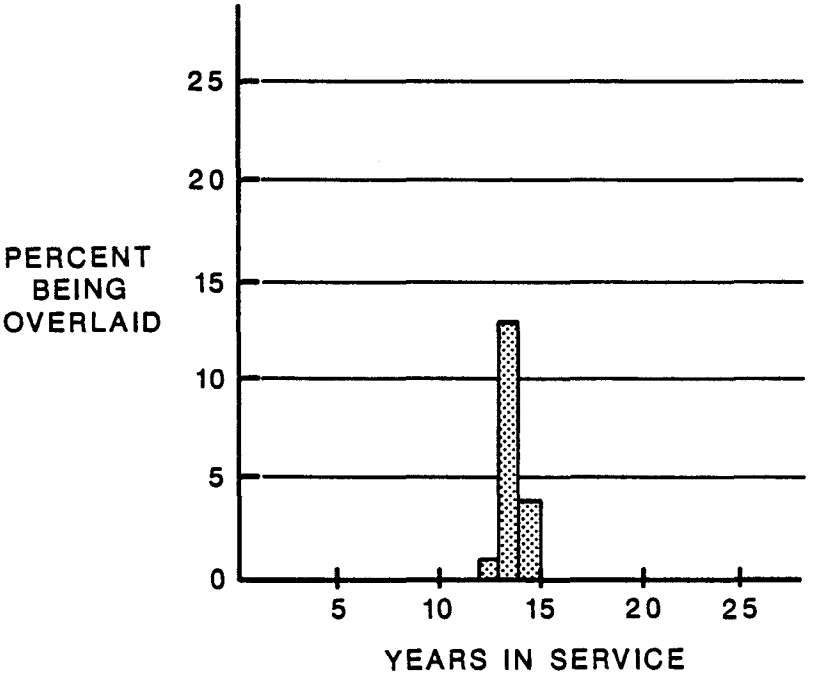

Figure A15. Percentage of CRCP overlaid each year of service

Figure A16 Failure Summary Chart

(District 24)

ID	Section Length	Failures/Mile/Year F/M/Y	Failures/Section/Year F/S/Y
4022 EB	2.6	.22	.57
4023 EB	1.6	.17	.28
4020 EB	11.2	.04	.50
4014 EB	12.0	.02	.31
4012 EB	0.8	.09	.07
4011 EB	9.6	.02	.21
4009 EB	2.4	.03	.06
4010 EB	7.2	.03	.22
4010 WB	7.2	.06	.44
4009 WB	3.0	.05	.15
4011 WB	9.2	.02	.21
4012 WB	0.8	.09	.07
4014 WB	12.2	.06	.71
4020 WB	11.8	.10	1.25
4023 WB	1.2	.09	.11
4022 WB	2.4	.05	.11
TOTALS	95.2		5.27

PROJECT LEVEL DETAILED

PERFORMANCE DATA

DISTRICT 20

BEAUMONT, TEXAS

FROM: WALDEN ROAD IN BEAUMONT
TO: 0.6 MILES NORTHEAST OF FM 365

PROJECT AND SECTION IDENTIFICATION

CFTR No: 0004
DISTRICT: 20
HIGHWAY: IH-10
COUNTY: Jefferson
CONTROL SECTION: 739-2-6
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 6/63
LENGTH OF SECTION: 9.3 miles
COST PER MILE (ONE DIRECTION): $ 141,243
LAYER DESCRIPTION
BASE:
SUBBASE:
SUBGRADE:
*** NO Original Plans are Available.
STEEL CONFIGURATION
LONGITUDINAL:
TRANSVERSE:

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE:
TYPE OF FINE AGRREGATE:
CEMENT FACTOR:
WATER FACTOR:
*** Microfilm Missing
TYPE OF CURING:
CONCRETE MEAN STRENGTH:
STEEL YIELD POINT
4 BAR:
5 BAR:

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 10/73 (Maintenance)
COST PER MILE: $ 1,083
TYPE: Concrete Repairs

DATE COMPLETED: 9/75 (Contract)
COST PER MILE: 139,059
TYPE: Resurf will ACP and Plant Mix Seal.

DATE COMPLETED: 1/76 (Maintenance)
COST PER MILE: $ 1,174
TYPE: Reconst. of the Shoulders.

DATE COMPLETED: 3/84 (Contract)
COST PER MILE: 150,223
TYPE: Concrete Repairs, Rubber Seal and ACP Overlay.

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Good.
PLANNED OVERLAY DATE: Not in the budget for 1988.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 53.8
AIR FREEZE/THAW PER YEAR: 8.0

TRAFFIC DATA

ADT (1986): 12,225
% TRUCKS: 25.1%
CUMMU. 18 KIPS TO 1986: 15,890,000
CUMMU. 18 KIPS TO REHAB: 4,577,000 (1974)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
11	100	0.0	3.1
15	4	---	---
17	4	---	---
19	0	---	---

FROM: THE CHAMBERS COUNTY LINE
TO: 0.6 MILES NORTHEAST OF FM 365

PROJECT AND SECTION IDENTIFICATION

CFTR No: 0009
DISTRICT: 20
HIGHWAY: IH-10
COUNTY: Jefferson
CONTROL SECTION: 739-2-9
DIRECTION: East Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION:
LENGTH OF SECTION:
COST PER MILE (ONE DIRECTION):
LAYER DESCRIPTION
BASE:
SUBBASE:
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL:
TRANSVERSE:

*** No Original Plans are Available.

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE:
TYPE OF FINE AGRREGATE:
CEMENT FACTOR:
WATER FACTOR:
TYPE OF CURING:
CONCRETE MEAN STRENGTH:
STEEL YIELD POINT
4 BAR:
5 BAR:

*** NO Microfilm.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 10/73 (Maintenance)
COST PER MILE: $ 1,083
TYPE: Concrete Pavement Repairs.

DATE COMPLETED: 1/76 (Maintenance)
COST PER MILE: $ 1,174
TYPE: Reconst. of the Shoulders.

DATE COMPLETED: 5/81 (Contract)
COST PER MILE: $ 411,239
TYPE: Hot Rubber Asphalt Seal and ACP Overlay.

DATE COMPLETED: 3/82 (Contract)
COST PER MILE: $ 335,066
TYPE: Hot Asphalt Rubber Seal and ACP Overlay.

DATE COMPLETED: 7/84 (Maintenance)
COST PER MILE: $ 2,135
TYPE: Concrete Repairs.

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Good.
PLANNED OVERLAY DATE: Not in the budget for 1988.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 53.8
AIR FREEZE/THAW PER YEAR: 8.0

TRAFFIC DATA

ADT (1986): 11,500
% TRUCKS: 25.9%
CUMMU. 18 KIPS TO 1986: 15,635,000
CUMMU. 18 KIPS TO REHAB: 9,561,000 (1981)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
10	100	0.0	2.8
14	100	2.4	12.4
16	100	3.3	22.0
18	0	---	---

FROM: CLEVELAND (NORTH CITY LIMITS)
TO: THE SAN JACINTO COUNTY LINE

PROJECT AND SECTION IDENTIFICATION

CFTR No: 0015
DISTRICT: 20
HIGHWAY: US-59
COUNTY: Liberty
CONTROL SECTION: 177-3-27
DIRECTION: South Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment (one course)
WIDTH OF SHOULDERS: 10'out. 6'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 6/66
LENGTH OF SECTION: 2.0 miles
COST PER MILE (ONE DIRECTION): $ 184,951
LAYER DESCRIPTION
BASE: 5" Compact Cement Stab. Base
SUBBASE: Existing Old Road
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=18.26
TRANSVERSE: #4 bars @24"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Partial Crushed Silic. Gravel(L.A.=25)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 4.5
WATER FACTOR: 6.0
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 51,600
5 BAR: 71,600

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 11/72 (Maintenance)
COST PER MILE: $ 3,779
TYPE: Concrete Pavement Repairs.

DATE COMPLETED: 1/74 (Maintenance)
COST PER MILE: $ 9,541
TYPE: Concrete Pavement Repairs.

DATE COMPLETED: 11/75 (Maintenance)
COST PER MILE: $ 10,495
TYPE: Concrete Pavement Repairs.

DATE COMPLETED: 9/78 (Maintenance)
COST PER MILE: 7,692
TYPE: Concrete Pavement Repairs.

DATE COMPLETED: 8/82 (Maintenance)
COST PER MILE: $ 2,206
TYPE: Seal Coat Shoulders.

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Poor.
PLANNED OVERLAY DATE: Not in the budget for 1988.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 58.2
AIR FREEZE/THAW PER YEAR: 13.3

TRAFFIC DATA

ADT (1986): 9,425
% TRUCKS: 14.5%
CUMMU. 18 KIPS TO 1986: 15,905,000
CUMMU. 18 KIPS TO REHAB: -0- (Not Overlayed)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
8	100	0.0	0.0
12	87	149.6	9.6
16	87	161.7	15.4
18	80	239.6	92.1

FROM: WESCALDER ROAD IN BEAUMONT
TO: 2.8 MILES WEST

PROJECT AND SECTION IDENTIFICATION

CFTR No: 0018
DISTRICT: 20
HIGHWAY: US-90
COUNTY: Jefferson
CONTROL SECTION: 28-6-32
DIRECTION: East Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment (one course)
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 11/66
LENGTH OF SECTION: 2.8 miles
COST PER MILE (ONE DIRECTION): $ 256,643
LAYER DESCRIPTION
BASE: 4" Cement Stab. Base
SUBBASE: 6" Lime Stab. Subgrade
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5bars A=3, B=6, C=7.5 #bars=39 lb/sy=18.26
TRANSVERSE: #4bars @24"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Partial Crushed Silic. Gravel(L.A.=24)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 4.5
WATER FACTOR: 6.2
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 50,000 psi.
5 BAR: 51,300 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED:
COST PER MILE:
TYPE:

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Fair. Lots of spalling/cracking.
PLANNED OVERLAY DATE: Possibly in the summer 1989.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 53.8
AIR FREEZE/THAW PER YEAR: 8.0

TRAFFIC DATA

ADT (1986): 4,425
% TRUCKS: 8.7%
CUMMU. 18 KIPS TO 1986: 2,436,000
CUMMU. 18 KIPS TO REHAB: -0- (Not Overlayed)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mlie
7	100	0.0	0.7
11	100	236.7	0.3
13	100	346.7	0.7
15	100	362.3	6.0

FROM: 3.5 MILES WEST OF WESCALDER ROAD
TO: 6.0 MILES WEST

PROJECT AND SECTION IDENTIFICATION

CFTR No: 0021
DISTRICT: 20
HIGHWAY: US-90
COUNTY: Jefferson
CONTROL SECTION: 28-6-35
DIRECTION: East Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment (one course)
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 7/69
LENGTH OF SECTION: 5.66 miles
COST PER MILE (ONE DIRECTION): $ 262,107
LAYER DESCRIPTION
BASE: 4" Cement Stab. Base
SUBBASE: 6" Lime Stab. Subgrade
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=17.66
TRANSVERSE: #4 bars @30"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Partial.Crushed Silic. Gravel(L.A.=23)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 4.5 to 5.0
WATER FACTOR: 5.1 to 6.1
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: 4,455 psi.
STEEL YIELD POINT
4 BAR: 53,403
5 BAR: 50,825

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED:
COST PER MILE:
TYPE:

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Fair. Lots of spalling/cracking.
PLANNED OVERLAY DATE: Possibly in the summer of 1989.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 53.8
AIR FREEZE/THAW PER YEAR: 8.0

TRAFFIC DATA

ADT (1986): 2,950
% TRUCKS: 10.5%
CUMMU. 18 KIPS TO 1986: 2,001,000
CUMMU. 18 KIPS TO REHAB: -0- (Not Overlayed)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
5	100	0.0	0.0
9	92	155.4	0.2
11	92	230.7	2.0
13	92	230.7	3.9

FROM: 0.4 MILES WEST OF AVENUE A, EAST
TO: 0.2 MILES WEST OF SPUR 380

PROJECT AND SECTION IDENTIFICATION

CFTR No: 0023
DISTRICT: 20
HIGHWAY: US-69
COUNTY: Jefferson
CONTROL SECTION: 200-14-26
DIRECTION: South Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment (one course)
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 5/71
LENGTH OF SECTION: 2.2 miles
COST PER MILE (ONE DIRECTION): $ 759,598
LAYER DESCRIPTION
BASE: 6" Cement Stab. Sand Shell
SUBBASE: 6" Lime Stab. Subgrade
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #3 bars A=4.5, B=9.5, C= lb/sy=6.61
TRANSVERSE: #4 bars @30"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Silicious Gravel (L.A.=25)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 5.0 to 5.5
WATER FACTOR: 5.4 to 5.5
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: Not Available
5 BAR: Not Available

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 8/72/(Maintenance)
COST PER MILE: $ 1,896
TYPE: Concrete Pavement Repairs.

DATE COMPLETED: 1/82 (Maintenance)
COST PER MILE: $ 1,280
TYPE: Seal Coat on Shoulders.

DATE COMPLETED: 2/82 (Maintenance)
COST PER MILE: $ 9,136
TYPE: Pressure Grout Concrete Pavement.

DATE COMPLETED: 7/84 (Maintenance)
COST PER MILE: $ 8,284
TYPE: Concrete Pavement Repairs.

DATE COMPLETED: 2/86
COST PER MILE: $ 5,466
TYPE: Concrete Pavement Repairs.

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Good.
PLANNED OVERLAY DATE: Not in the budget for 1988.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 53.8
AIR FREEZE/THAW PER YEAR: 8.0

TRAFFIC DATA

ADT (1986): 21,500
% TRUCKS: 5.3%
CUMMU. 18 KIPS TO 1986: 7,049.000
CUMMU. 18 KIPS TO REHAB: -0- (Not Overlayed)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
3	100	0.0	0.4
7	100	6.2	1.2
9	100	11.7	2.1
11	100	11.7	9.2

DISTRICT 1

PARIS TEXAS

FROM: THE ROCK CREEK
TO: THE EAST END OF THE CANEY CREEK BRIDGE

PROJECT AND SECTION IDENTIFICATION

CFTR No: 01001
DISTRICT: 1
HIGHWAY: IH-30
COUNTY: Hopkins
CONTROL SECTION: 10-2-23
DIRECTION: East Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment (two course)
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 5/64
LENGTH OF SECTION: 6 miles
COST PER MILE (ONE DIRECTION): $ 133,576
LAYER DESCRIPTION
BASE: 6" Aggregate Base
SUBBASE: 6" Aspalt Stab. Subbase
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=18.26
TRANSVERSE: #4 bars @24"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Crushed Limestone (L.A.= 26.6)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 4.5 to 4.8
WATER FACTOR: 6.2 to 6.4
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: 4,860 psi. Slump = 2"
STEEL YIELD POINT
4 BAR: 52,700 psi.
5 BAR: 65,100 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 8/86 (Contract)
COST PER MILE: $ 203,612
TYPE: Rework on the Shoulders and ACP Overlay.

DATE COMPLETED: 3/87 (Contract)
COST PER MILE: $ 5,833
TYPE: Level Up and Seal Coat.

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 46.1
AIR FREEZE/THAW PER YEAR: 39.9

TRAFFIC DATA

ADT (1986): 8,050
% TRUCKS: 29.6%
CUMMU. 18 KIPS TO 1986: 19,160,000
CUMMU. 18 KIPS TO REHAB: 19,160,000 (1986)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
10	100	0.0	3.7
14	94	3.2	4.5
16	94	4.8	5.8
18	87	4.8	10.0
20	50	---	---

FROM: THE EAST END OF THE CANEY CREEK BRIDGE
TO: THE FRANKLIN COUNTY LINE

PROJECT AND SECTION IDENTIFICATION

CFTR No: 01003
DISTRICT: 1
HIGHWAY: IH-30
COUNTY: Hopkins
CONTROL SECTION: 610-1-4-
DIRECTION: East Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment (two course)
WIDTH OF SHOULDERS: 10'out. 4' ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 9/65
LENGTH OF SECTION: 6.1 miles
COST PER MILE (ONE DIRECTION): $ 145,047
LAYER DESCRIPTION
BASE: 6" Soil Cement Base
SUBBASE: 6" Stab. Asphalt Base
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=18.26
TRANSVERSE: #4 bars @24"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Crushed Limestone (L.A.=26)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 4.5
WATER FACTOR: 6.6
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 51,500 psi.
5 BAR: 60,000 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 8/86 (Contract)
COST PER MILE: $ 221,192
TYPE: Rework Shoulders, ASB and ACP Overlay.

DATE COMPLETED:
COST PER MILE:
TYPE:

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 46.1
AIR FREEZE/THAW PER YEAR: 39.9

TRAFFIC DATA

ADT (1986): 6,400
% TRUCKS: 33.4%
CUMMU. 18 KIPS TO 1986: 16,959,000
CUMMU. 18 KIPS TO REHAB: 16,959,000 (1986)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
9	100	0.0	0.8
13	94	4.5	0.8
15	94	5.3	2.8
17	90	5.5	3.8
19	37	---	---

FROM: FM 899 SOUTH OF MT. VERNON
TO: THE TITUS COUNTY LINE

PROJECT AND SECTION IDENTIFICATION

CFTR No: 01005
DISTRICT: 1
HIGHWAY: IH-30
COUNTY: Franklin
CONTROL SECTION: 610-2-4
DIRECTION: East Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment (two course)
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 12/65
LENGTH OF SECTION: 5.4 miles
COST PER MILE (ONE DIRECTION): $ 141,068
LAYER DESCRIPTION
BASE: 6" Soil Cement Base
SUBBASE: 6" Asphalt Stab. Roadbed
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=18.26
TRANSVERSE: #4 bars @24"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Crushed Limestone (L.A.=37.6)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 4.5
WATER FACTOR: 6.5
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 66,000 psi.
5 BAR: 57,200 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 3/85 (Contract)
COST PER MILE: $ 213,385
TYPE: Concrete Pavement Repairs and ACP Overlay.

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 45.8
AIR FREEZE/THAW PER YEAR: 39.0

TRAFFIC DATA

ADT (1986): 6,500
% TRUCKS: 33.6%
CUMMU. 18 KIPS TO 1986: 19,002,000
CUMMU. 18 KIPS TO REHAB: 16,609,000 (1985)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
9	100	0.0	0.6
13	100	3.9	1.1
15	100	6.3	2.4
17	100	6.3	4.1

FROM: FM 902 UNDERPASS
TO: 0.5 MILES NORTH OF THE COLLINS COUNTY LINE

PROJECT AND SECTION IDENTIFICATION

CFTR No: 01008
DISTRICT: 1
HIGHWAY: US-75
COUNTY: Grayson
CONTROL SECTION: 47-13-4
DIRECTION: North Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment (two course)
WIDTH OF SHOULDERS: 10'out. 5'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 8/67
LENGTH OF SECTION: 9 miles
COST PER MILE (ONE DIRECTION): $ 156,139
LAYER DESCRIPTION
BASE: 6" Lime Stab. Flex. Base
SUBBASE: 6" Lime Treated Subgrade
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=17.66
TRANSVERSE: #4 bars @30"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Crushed Dolomitic Limestone (L.A.=27)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 4.5
WATER FACTOR: 6.5
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 64,500 psi.
5 BAR: 62,785 psi

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 8/80 (Maintenance)
COST PER MILE: $ 6,533
TYPE: Seal Coat on Shoulders.

DATE COMPLETED: 8/85 (Contract)
COST PER MILE: $ 333,383
TYPE: Concrete Repairs and ACP Overlay.

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 38.1
AIR FREEZE/THAW PER YEAR: 35.0

TRAFFIC DATA

ADT (1986): 8,300
% TRUCKS: 17.8%
CUMMU. 18 KIPS TO 1986: 12,266,000
CUMMU. 18 KIPS TO REHAB: 10,685,000 (1985)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
7	100	0.0	0.2
11	100	0.9	2.2
13	100	10.3	3.9
15	93	10.3	4.9
17	93	---	---

FROM: THE JUNCTION WITH LOOP 286
TO: THE PINE CREEK

PROJECT AND SECTION IDENTIFICATION

CFTR No: 01012
DISTRICT: 1
HIGHWAY: US-271
COUNTY: Lamar
CONTROL SECTION: 136-7-30
DIRECTION: North Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment (two course)
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 9/71
LENGTH OF SECTION: 2.0 miles
COST PER MILE (ONE DIRECTION): $ 317,585
LAYER DESCRIPTION
BASE: 2" Asphalt Stab. Base
SUBBASE: 6" Flexible Base
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=17.66
TRANSVERSE: #4 bars @30"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Crushed Limestone (L.A.=23.5)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: Not Available
WATER FACTOR: Not Available
TYPE OF CURING: Not Available
CONCRETE MEAN STRENGTH: 5,507 psi.
STEEL YIELD POINT
4 BAR: Not Available
5 BAR: Not Available

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 3/81 (Maintenance)
COST PER MILE: $ 5,751
TYPE: Reshape and Seal Shoulders.

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 47.2
AIR FREEZE/THAW PER YEAR: 38.1

TRAFFIC DATA

ADT (1986): 5,550
% TRUCKS: 16.3%
CUMMU. 18 KIPS TO 1986: 7,558,000
CUMMU. 18 KIPS TO REHAB: -0- (Not Overlayed)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
3	100	0.0	0.0
6	100	46.8	0.5
9	100	72.7	0.9
11	90	74.5	2.0
13	80	---	8.1

FROM: 0.4 MILES EAST OF THE S.P. RAILROAD
TO: FM. 1417 OVERPASS

PROJECT AND SECTION IDENTIFICATION

CFTR No: 01015
DISTRICT: 1
HIGHWAY: US-82
COUNTY: Grayson
CONTROL SECTION: 45-19-4
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment
WIDTH OF SHOULDERS: 10'out. 6'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 6/75
LENGTH OF SECTION: 3.3 miles
COST PER MILE (ONE DIRECTION): $ 500,024
LAYER DESCRIPTION
BASE: 2" ACP (type D)
SUBBASE: 6" Scarified & Reshape of Existing Flex. Base
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=17.25
TRANSVERSE: #4 bars @36"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE:
TYPE OF FINE AGRREGATE:
CEMENT FACTOR:
WATER FACTOR:
TYPE OF CURING:
CONCRETE MEAN STRENGTH:
STEEL YIELD POINT
4 BAR:
5 BAR:

*** No Information Available for this Section in the Microfilms.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED:
COST PER MILE:
TYPE:

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 38.1
AIR FREEZE/THAW PER YEAR: 35.0

TRAFFIC DATA

ADT (1986): 3,750
% TRUCKS: 9%
CUMMU. 18 KIPS TO 1986: 1,557,000
CUMMU. 18 KIPS TO REHAB: -0- (Not Overlayed)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
3	100	0.0	0.0
5	100	0.8	0.5
7	100	0.8	1.1
9	100	2.5	1.9

DISTRICT 20

AMARILLO, TEXAS

FROM: 400 FT. WEST OF GARFIELD STREET
TO: NELSON STREET IN AMARILLO

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4002
DISTRICT: 4
HIGHWAY: IH-40
COUNTY: Potter
CONTROL SECTION: 275-1-11
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 3&4
LANE WIDTH: 12'
TYPE OF SHOULDERS: Asphalt Concrete
WIDTH OF SHOULDERS: 10'out. 12'median

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 10/64
LENGTH OF SECTION: 1.34 miles
COST PER MILE (ONE DIRECTION): $ 788,830 (incl. Front. Roads)
LAYER DESCRIPTION
BASE: 6" Lime Stab. Flex. Base
SUBBASE: 6" Lime Stab. Subgrade
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bar A=3, B=6, C=7.5 #bars=39 lb/sy=18.26
TRANSVERSE: #4 bar @24"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Partially Crushed Limestone (L.A.=28)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 5.0
WATER FACTOR: Not Available
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 48,200 psi.
5 BAR: 62,700 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 4/74 (Maintenance)
COST PER MILE: $ 6,104
TYPE: Asph. Concrete Pavement and Seal Coat in sections.

DATE COMPLETED: 12/83 (Contract)
COST PER MILE: $ 265,018
TYPE: Rubber Seal and ACP Overlay.

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Fair. Some pushing and shoving.
PLANNED OVERLAY DATE: Not in budget for 1988.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 19.8
AIR FREEZE/THAW PER YEAR: 81.1

TRAFFIC DATA

ADT (1986): 33,000
% TRUCKS: 10.7%
CUMMU. 18 KIPS TO 1986: 23,560,000
CUMMU. 18 KIPS TO REHAB: 18,410,000 (1983)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
10	100	0.0	0.0
14	100	1.2	0.0
18	100	1.2	0.0
20	20	---	---

FROM: 2.0 MILES EAST OF THE POTTER COUNTY LINE
TO: 4.0 MILES WEST OF CONWAY COUNTY

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4005
DISTRICT: 4
HIGHWAY: IH-40
COUNTY: Carson
CONTROL SECTION: 275-2-12
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Asphalt Concrete
WIDTH OF SHOULDERS: 10'out. 6'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 11/66
LENGTH OF SECTION: 8 miles
COST PER MILE (ONE DIRECTION): $ 177,706 (incl. Frontage Roads)
LAYER DESCRIPTION
BASE: 4" Asphalt Stab. Base
SUBBASE: 6" Lime Treated Subgrade
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bar A=3, B=6, C=7.5 #bars=39 lb/sy=17.66
TRANSVERSE: #4 bar @30"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Silicious Gravel (L.A.=30)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 5.2 to 5.6
WATER FACTOR: 5.8
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 55,500 psi.
5 BAR: 64,100 psi.

*** Same material characteristics as CFTR 4006.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 8/79 (Maintenance)
COST PER MILE: $ 4,208
TYPE: Seal Coat on Frontage Roads and Main Lane Shoulders.

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Poor.
PLANNED OVERLAY DATE: Summer/88. Contract has been issued.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 20.2
AIR FREEZE/THAW PER YEAR: 82.5

TRAFFIC DATA

ADT (1986): 4,300
% TRUCKS: 43.4%
CUMMU. 18 KIPS TO 1986: 11,835,000
CUMMU. 18 KIPS TO REHAB: -0- (Not Overlayed)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
8	100	0.0	0.0
12	100	3.5	1.0
16	100	3.5	5.5
18	50	---	---

FROM: 4.0 MILES WEST OF CONWAY
TO: 1.6 MILES EAST OF CONWAY

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4006
DISTRICT: 4
HIGHWAY: IH-40
COUNTY: Carson
CONTROL SECTION: 275-3-15
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Asphalt Concrete
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 11/66
LENGTH OF SECTION: 6 miles
COST PER MILE (ONE DIRECTION): $ 155,041
LAYER DESCRIPTION
BASE: 4" Asphalt Stab. base
SUBBASE: 6" Lime Treated Subgrade
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bar A=3, B=6, C=7.5 #bars=39, lb/sy=17.66
TRANSVERSE: #4 bar @30"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Silicious Gravel (L.A.=30)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 5.2 to 5.6
WATER FACTOR: 5.8
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 55,500 psi.
5 BAR: 64,100 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 8/79 (Maintenance)
COST PER MILE: $ 2,653
TYPE: Seal Coat on Frontage Roads and Main Lane Shoulders.

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Fair
PLANNED OVERLAY DATE: Summer/88. Contract has been issued.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 20.2
AIR FREEZE/THAW PER YEAR: 82.5

TRAFFIC DATA

ADT (1986): 4,175
% TRUCKS: 44.4%
CUMMU. 18 KIPS TO 1986: 11,683,000
CUMMU. 18 KIPS TO REHAB: -0- (Not Overlayed)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
8	100	0.0	0.7
12	100	1.7	0.3
16	100	1.7	2.2
18	73	---	---

FROM: 0.8 MILES EAST OF PULLMAN ROAD
TO: THE CARSON/POTTER COUNTY LINE

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4010
DISTRICT: 4
HIGHWAY: IH-40
COUNTY: Potter
CONTROL SECTION: 275-1-31
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Asphalt Concrete
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 12/68
LENGTH OF SECTION: 4.2 miles
COST PER MILE (ONE DIRECTION): $ 265,161
LAYER DESCRIPTION
BASE: 4" Asphalt Stab. Base
SUBBASE: 6" Lime Treated Subgrade
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bar A=3, B=6, C=7.5 #bars=39 lb/sy=17.66
TRANSVERSE: #4 bar @30"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Silicious & Limestone Gravel (L.A.=30)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 5.5
WATER FACTOR: 5.5
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 72,821 psi.
5 BAR: 70,130 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 9/74 (Maintenance)
COST PER MILE: $ 6,104
TYPE: Asph. Concrete Pavement and Seal Coat in sections.

DATE COMPLETED: 12/83 (Contract)
COST PER MILE: $ 265,018
TYPE: Rubber Seal and ACP Overlay.

DATE COMPLETED: 6/85 (Contract)
COST PER MILE: $ 108,655
TYPE: Rubber Seal and ACP Overlay.

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Fair. The overlay bond is weak.
PLANNED OVERLAY DATE: Not in the budget for 1988.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 19.8
AIR FREEZE/THAW PER YEAR: 81.1

TRAFFIC DATA

ADT (1986): 6,025
% TRUCKS: 37.4%
CUMMU. 18 KIPS TO 1986: 12,905,000
CUMMU. 18 KIPS TO REHAB: 9,194,000 (1983)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
6	100	0.0	0.0
10	100	4.1	0.2
14	100	4.1	1.1
16	90	6.7	2.2

FROM: 2.0 MILES WEST OF BUSHLAND
TO: 1.0 MILE WEST OF THE CRI&P RR.

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4011
DISTRICT: 4
HIGHWAY: IH-40
COUNTY: Potter
CONTROL SECTION: 90-5-44
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Asphalt Concrete
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 6/72
LENGTH OF SECTION: 6.7 miles
COST PER MILE (ONE DIRECTION): $ 161,304
LAYER DESCRIPTION
BASE: 6" Asphalt Stab. Base
SUBBASE: 6" Lime Treated Subgrade
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: ** NO PLANS AVAILABLE
TRANSVERSE:

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Silicious & Limestone Gravel (L.A.=29)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 5.5
WATER FACTOR: 5.1 to 5.3
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: Not Available
5 BAR: Not Available

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED:
COST PER MILE:
TYPE:

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Fair.
PLANNED OVERLAY DATE: Not in the budget for 1988.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 19.8
AIR FREEZE/THAW PER YEAR: 81.1

TRAFFIC DATA

ADT (1986): 5,025
% TRUCKS: 32%
CUMMU. 18 KIPS TO 1986: 10,014,000
CUMMU. 18 KIPS TO REHAB: -0- (Not Overlayed)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
2	100	0.0	0.1
6	100	2.4	0.5
10	100	2.4	2.8
12	94	6.6	3.7

FROM: THE CARSON/POTTER COUNTY LINE
TO: 2.0 MILES EAST IN CARSON COUNTY

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4012
DISTRICT: 4
HIGHWAY: IH-40
COUNTY: Carson
CONTROL SECTION: 275-2-15
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Asphalt Concrete
WIDTH OF SHOULDERS: 10'out. 4'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 11/68
LENGTH OF SECTION: 2.2 miles
COST PER MILE (ONE DIRECTION): $ 253,205
LAYER DESCRIPTION
BASE: 4" Aspalt Stab. Base
SUBBASE: 6' Lime Treated Subgrade
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bar A=3, B=6, C=7.5 #bars=39 lb/sy=17.66
TRANSVERSE: #4 bar @30"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Silicious & Limestone Gravel (L.A.=30)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 5.5
WATER FACTOR: 5.5
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 72,821 psi.
5 BAR: 70,130 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 8/79 (Maintenance)
COST PER MILE: $ 4,208
TYPE: Seal Coat on Frontage Roads and Main Lane Shoulders.

DATE COMPLETED: 6/85 (Contract)
COST PER MILE: $ 94,355
TYPE: Rubber Seal and ACP Overlay.

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD: Poor. The overlay lost its bond.
PLANNED OVERLAY DATE: Not in budget for 1988. Maintenance only.

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 20.2
AIR FREEZE/THAW PER YEAR: 82.5

TRAFFIC DATA

ADT (1986): 4,600
% TRUCKS: 42.2%
CUMMU. 18 KIPS TO 1986: 9,234,000
CUMMU. 18 KIPS TO REHAB: 8,639,000 (1985)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
6	100	0.0	0.0
10	100	0.8	0.4
14	100	6.2	0.4
16	100	---	2.1

DISTRICT 24

EL PASO, TEXAS

FROM: SAN MARCIAL STREET
TO: CALFOX STREET IN EL PASO

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4004
DISTRICT: 24
HIGHWAY: IH-10
COUNTY: El Paso
CONTROL SECTION: 2121-2-8
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 4
LANE WIDTH: 12'
TYPE OF SHOULDERS: Asph. Concrete
WIDTH OF SHOULDERS: Max 10' Min 4'

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 10/64
LENGTH OF SECTION: 2.02 miles
COST PER MILE (ONE DIRECTION): $ 246,114 (Grading not Included)
LAYER DESCRIPTION
BASE: 6.5" Flexible Base
SUBBASE: 6" Soil Cement Base
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=18.26
TRANSVERSE: #4 bars @24"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Crushed Limestone (L.A.=26.4)
TYPE OF FINE AGRREGATE: Silicious Sand
CEMENT FACTOR: 4.5 to 4.6
WATER FACTOR: 6.2 to 6.3
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: Not Available
STEEL YIELD POINT
4 BAR: 56,923 psi.
5 BAR: 58,224 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 7/83 (Maintenance)
COST PER MILE: $ 17,708
TYPE: Joint Sealer and Shoulder Repairs.

DATE COMPLETED: 7/83 (Maintenance)
COST PER MILE: $ 21,280
TYPE: Hot Asphalt Rubber Seal on Shoulders.

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 8.1
AIR FREEZE/THAW PER YEAR: 66.4

TRAFFIC DATA

ADT (1986): 67,500
% TRUCKS: 6.5%
CUMMU. 18 KIPS TO 1986: 21,834,000
CUMMU. 18 KIPS TO REHAB: -0- (Not Overlayed)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
22	100	1.1	0.0
24	100	1.1	0.4

FROM: 0.6 MILES WEST OF KENT
TO: THE JEFF DAVIS/REEVES COUNTY LINE

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4009
DISTRICT: 24
HIGHWAY: IH-10
COUNTY: Culberson
CONTROL SECTION: 3-3-19
DIRECTION: East Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment
WIDTH OF SHOULDERS: 10'out 6'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 7/69
LENGTH OF SECTION: 2.8 miles
COST PER MILE (ONE DIRECTION): $ 345,151
LAYER DESCRIPTION
BASE: 4" Type A Grade Base
SUBBASE: 4" Asphalt Stab. Subbase
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=17.66
TRANSVERSE: #4 bars @30"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Crushed Limestone (L.A.=29.2)
TYPE OF FINE AGRREGATE: Silicious & Limestone Sand
CEMENT FACTOR: 5.0
WATER FACTOR: 6.0 to 6.3
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: 4,943 psi.
STEEL YIELD POINT
4 BAR: 60,824 psi.
5 BAR: 67,559 psi

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 9/72 (Maintenance)
COST PER MILE: $ 1,474
TYPE: Seal Coat on Shoulders.

DATE COMPLETED: 10/86 (Maintenance)
COST PER MILE: $ 35,104
TYPE: Level Up and Seal Coat on Shoulders.

DATE COMPLETED: 1/87 (Contract)
COST PER MILE: $ 16,977
TYPE: Hot Asphalt Rubber Seal.

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 10.2
AIR FREEZE/THAW PER YEAR: 59.7

TRAFFIC DATA

ADT (1986): 3,950
% TRUCKS: 40.3%
CUMMU. 18 KIPS TO 1986: 12,237,000
CUMMU. 18 KIPS TO REHAB: 12,237,000 (1986)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
5	100	0.0	0.0
9	100	0.3	0.0
13	100	0.3	0.0
15	86	2.5	0.4

FROM: THE CULBERSON COUNTY LINE
TO: THE REEVES COUNTY LINE

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4010
DISTRICT: 24
HIGHWAY: IH-10
COUNTY: Jeff Davis
CONTROL SECTION: 3-4-22
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Asphalt Concrete
WIDTH OF SHOULDERS: 10' out. 6'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 7/69
LENGTH OF SECTION: 7 miles
COST PER MILE (ONE DIRECTION): $ 280,282
LAYER DESCRIPTION
BASE: 4" Type A Grade Base
SUBBASE: 4" Asphalt Stab. Subbase
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL: #5 bars A=3, B=6, C=7.5 #bars=39 lb/sy=17.66
TRANSVERSE: #4 bars @30"

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Crushed Limestone (LA.=29.2)
TYPE OF FINE AGRREGATE: Silicious & Limestone Sand
CEMENT FACTOR: 5.0
WATER FACTOR: 6.0 to 6.3
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: 4,908 psi.
STEEL YIELD POINT
4 BAR: 60,800 psi.
5 BAR: 68,450 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 9/72 (Maintenance)
COST PER MILE: $ 1,455
TYPE: Seal Coat on Shoulders.

DATE COMPLETED: 10/86 (Contract)
COST PER MILE: $ 148,795
TYPE: Seal Shoulders and ACP Overlay.

DATE COMPLETED: 1/87 (Contract)
COST PER MILE: $ 17,519
TYPE: Hot Asphalt Rubber Seal.

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 19.1
AIR FREEZE/THAW PER YEAR: 44.4

TRAFFIC DATA

ADT (1986): 3,950
% TRUCKS: 40.3%
CUMMU. 18 KIPS TO 1986: 12,237,000
CUMMU. 18 KIPS TO REHAB: 12,237,000 (1986)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
5	100	0.0	0.0
9	100	1.2	0.2
13	100	1.2	0.2
15	88	2.7	0.2

FROM: BORRACHO STATION
TO: 0.6 MILES WEST OF KENT

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4011
DISTRICT: 24
HIGHWAY: IH-10
COUNTY: Culberson
CONTROL SECTION: 3-3-20
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment
WIDTH OF SHOULDERS: 10'out. 6'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 2/70
LENGTH OF SECTION: 9.6 miles
COST PER MILE (ONE DIRECTION): $ 207,408
LAYER DESCRIPTION
BASE:
SUBBASE:
SUBGRADE: *** Missing Original Plans.
STEEL CONFIGURATION
LONGITUDINAL:
TRANSVERSE:

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE: Crushed Limestone (L.A= 26.8)
TYPE OF FINE AGRREGATE: Silicious & Limestone Sand
CEMENT FACTOR: 5.0
WATER FACTOR: 6.0 to 6.3
TYPE OF CURING: Membrane
CONCRETE MEAN STRENGTH: 6,192 psi.
STEEL YIELD POINT
4 BAR: 60,789 psi.
5 BAR: 56,566 psi.

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 9/72 (Maintenance)
COST PER MILE: $ 1,474
TYPE: Seal Coat Shoulders.

DATE COMPLETED: 10/86 (Maintenance)
COST PER MILE: $ 35,104
TYPE: Seal Coat on Shoulders and Level Up.

DATE COMPLETED: 1/87 (Contract)
COST PER MILE: $ 16,977
TYPE: Hot Asphalt Rubber Seal.

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 10.2
AIR FREEZE/THAW PER YEAR: 59.7

TRAFFIC DATA

ADT (1986): 3,950
% TRUCKS: 40.3%
CUMMU. 18 KIPS TO 1986: 11,846,000
CUMMU. 18 KIPS TO REHAB: 11,846,000 (1987)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
4	100	0.0	0.0
8	100	1.1	0.2
12	100	1.1	0.0
14	96	5.8	0.2

FROM: MICHIGAN FLAT
TO: 1.14 MILES WEST OF BORRACHO STATION

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4014
DISTRICT: 24
HIGHWAY: IH-10
COUNTY: Culberson
CONTROL SECTION: 3-2-17
DIRECTION: East Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT: CRCP
THICKNESS: 8"
OF LANES (ONE DIRECTION): 2
LANE WIDTH: 12'
TYPE OF SHOULDERS: Bituminous Surface Treatment
WIDTH OF SHOULDERS: 10'out. 6'ins.

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION: 12/71
LENGTH OF SECTION: 12 miles
COST PER MILE (ONE DIRECTION): $ 227,945
LAYER DESCRIPTION
BASE:
SUBBASE:
SUBGRADE: *** Missing Original
STEEL CONFIGURATION Plans.
LONGITUDINAL:
TRANSVERSE:

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE:
TYPE OF FINE AGRREGATE:
CEMENT FACTOR:
WATER FACTOR:
TYPE OF CURING: *** No Information In
CONCRETE MEAN POINT Microfilm
STEEL YIELD STRENGTH
4 BAR:
5 BAR:

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 9/72 (Maintenance)
COST PER MILE: $ 1,565
TYPE: Seal Coat on Shoulders.

DATE COMPLETED: 10/86 (Maintenance)
COST PER MILE: $ 35,715
TYPE: Seal Coat On Shoulders.

DATE COMPLETED: 1/87 (Contract)
COST PER MILE: $ 18,484
TYPE: Hot Asphalt Rubber Seal.

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 10.2
AIR FREEZE/THAW PER YEAR: 59.7

TRAFFIC DATA

ADT (1986): 4,000
% TRUCKS: 39.8%
CUMMU. 18 KIPS TO 1986: 11,670,000
CUMMU. 18 KIPS TO REHAB: 11,670,000 (1986)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
3	100	0.0	0.0
7	100	3.0	0.1
11	100	3.0	0.1
13	100	6.2	0.3

FROM: 2.3 MILES WEST OF VAN HORN
TO: 43 FT. EAST OF US 90

PROJECT AND SECTION IDENTIFICATION

CFTR No: 4022
DISTRICT: 24
HIGHWAY: IH-10
COUNTY: Culberson
CONTROL SECTION: 3-1-25
DIRECTION: West Bound

GEOMETRIC INFORMATION

TYPE OF PAVEMENT:
THICKNESS:
OF LANES (ONE DIRECTION):
LANE WIDTH: *** No Data
TYPE OF SHOULDERS:
WIDTH OF SHOULDERS:

ORIGINAL CONSTRUCTION DATA

DATE OF COMPLETION:
LENGTH OF SECTION:
COST PER MILE (ONE DIRECTION):
LAYER DESCRIPTION
BASE: *** Missing Original Plans
SUBBASE:
SUBGRADE:
STEEL CONFIGURATION
LONGITUDINAL
TRANSVERSE

MATERIALS INFORMATION

TYPE OF COARSE AGGREGATE:
TYPE OF FINE AGRREGATE:
CEMENT FACTOR:
WATER FACTOR:
TYPE OF CURING: *** No Microfilm.
CONCRETE MEAN STRENGTH:
STEEL YIELD POINT
4 BAR:
5 BAR:

* This Section seems to be under control 2-11

MAJOR MAINTENANCE OR REHABILITATION

DATE COMPLETED: 10/86 (Maintenance)
COST PER MILE: $ 18,623
TYPE: Seal Coat on Shoulders.

DATE COMPLETED: 1/87 (Contract)
COST PER MILE: $ 17,218
TYPE: Hot Asphalt Rubber Seal.

DATE COMPLETED:
COST PER MILE:
TYPE:

PAVEMENT CONDITIONS

CURRENT CONDITION OF THE ROAD:
PLANNED OVERLAY DATE:

AVERAGE CLIMATIC CONDITIONS

RAINFALL (INCH/YEAR): 10.2
AIR FREEZE/THAW PER YEAR: 59.7

TRAFFIC DATA

ADT (1986): 3,800
% TRUCKS: 40.8%
CUMMU. 18 KIPS TO 1986: 8,745,000
CUMMU. 18 KIPS TO REHAB: 8,745,000 (1986)

PERFORMANCE DATA

Year	% Surviving	Severe Spalling Per Mile	Failures Per Mile
3	100	0.0	0.0
7	100	0.8	0.0
9	100	2.5	0.4