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PERFORMANCE EVALUATION OF VARIOUS HMA REHABILITATION STRATEGIES

Scott Shuler and Christopher Schmidt

December 2008

**COLORADO DEPARTMENT OF TRANSPORTATION
DTD APPLIED RESEARCH AND INNOVATION BRANCH**

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| <p>16. Abstract: This study evaluates the performance of eight hot mix asphalt (HMA) rehabilitation strategies utilized by the Colorado Department of Transportation (CDOT). The rehabilitation strategies are: 2 to 4-inch overlay without pretreatment; planing and overlay; stone matrix asphalt overlay; full-depth reclamation and overlay; heater scarification and overlay; heater remix and overlay; heater repaving and overlay; and cold-in-place recycling and overlay.</p> <p>Performance was evaluated with respect to six independent variables: (1) Performance Grade (PG) binder temperature range, (2) traffic volume, (3) highway classification, (4) maximum aggregate size, (5) CDOT region, and (6) climate.</p> <p>Data analyzed in the study was obtained from the CDOT Pavement Management System Program. Results of this analysis indicate that the cold planning and overlay strategy outperforms the other rehabilitation methods with two to four-inch overlays performing second best. The heater scarification and overlay strategy performed poorest of the eight strategies. The average time required for these pavements to reach the pre-rehabilitation condition was from six to fourteen years based on a linear regression model. However, this model may overestimate rehabilitation life span since it is likely that a linear relationship is not valid for the entire rehabilitation strategy life cycle.</p> <p>Pavements were rehabilitated before reaching the zero service life threshold except when fatigue cracking was present. In the case of fatigue cracking, four rehabilitation strategies studied exceeded the zero service life threshold. This indicates that rehabilitation would have been warranted earlier in the life of these pavements. As a result, the expected life of the rehabilitation strategies utilized on these pavements may be shorter than could be expected had rehabilitation been done before distress reached this high level. This may explain why the heater scarification and overlay strategy performed poorer than other techniques since fatigue distress prior to rehabilitation on these projects exceeded the zero remaining service life threshold by nearly 20 percent.</p> <p>Implementation: Continued transfer of pavement performance data from the Pavement Management Systems Program database is recommended to strengthen the validity of the data analysis.</p> | | | |
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EXECUTIVE SUMMARY

This study evaluates the performance of eight hot mix asphalt rehabilitation strategies utilized by the Colorado Department of Transportation (CDOT). These strategies are: two to 4-inch overlay without pretreatment; planing and overlay; stone matrix asphalt overlay; full-depth reclamation and overlay; heater scarification and overlay; heater remix and overlay; heater repaving and overlay; and cold-in-place recycling and overlay.

Performance was evaluated with respect to six independent variables: (1) Performance Grade (PG) binder temperature range, (2) traffic volume, (3) highway classification, (4) maximum aggregate size, (5) CDOT region, and (6) climate.

Data analyzed in the study was obtained from the CDOT Pavement Management Systems Program. Results of this analysis indicate that the cold planning and overlay strategy outperforms the other rehabilitation methods with two to four-inch overlays performing second best. The heater scarification and overlay strategy performed poorest of the eight strategies. The average time required for these pavements to reach the pre-rehabilitation condition was from six to fourteen years based on a linear regression model. However, this model may overestimate rehabilitation life span since it is likely that a linear relationship is not valid for the entire rehabilitation strategy life cycle.

Pavements were rehabilitated before reaching the zero-service life threshold except when fatigue cracking was present. In the case of fatigue cracking, four of the rehabilitation strategies studied exceeded the zero-service life threshold. This indicates that rehabilitation would have been warranted earlier in the life of these pavements. As a result, the expected life of the rehabilitation strategies utilized on these pavements may be shorter than could be expected had rehabilitation been done before distress reached this high level. This may explain why the heater scarification and overlay strategy performed poorer than other techniques since fatigue distress prior to rehabilitation on these projects exceeded the zero remaining service life threshold by nearly 20 percent.

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1.0 INTRODUCTION

The Colorado Department of Transportation (CDOT) is responsible for maintaining and rehabilitating approximately 23,105 lane miles of the 136, 287 lane miles in the state annually. Rehabilitation of these pavements is done periodically to maintain an acceptable level of serviceability. The cost of rehabilitation varies based on damage severity and the rehabilitation method. The budgets for rehabilitation of these pavements in fiscal years 2006 and 2007 were \$132.9 and \$153.0 millions, respectively.

This study is intended to provide an evaluation of the performance for eight of the rehabilitation methods utilized by CDOT for hot mix asphalt pavements. It is believed that each of these rehabilitation methods performs differently depending on how and where the method is being utilized. However, there has not been an extensive study examining the performance of each method, so relative performance and cost effectiveness of the rehabilitation strategies are not well understood. The purpose of this research is to quantify the performance of the eight rehabilitation strategies used in Colorado so that a better understanding can be gained regarding which rehabilitation strategies perform the best under specific conditions.

1.1 Hot Mix Asphalt (HMA) Rehabilitation Strategies

Below are definitions of the eight rehabilitation strategies investigated:

Cold Planing and Overlay

Cold planing and overlay involves removing the top portion of the existing pavement with a milling machine at ambient temperatures. This milled material is removed and later recycled. The milled pavement surface is then covered with a new hot mix asphalt pavement. This overlay is usually between 2 and 6 inches thick.

Two to Four-Inch Overlay

In a 2 to 4-inch overlay, a flexible pavement overlay is added to the existing pavement and then finished by leveling with a roller. The flexible pavement overlay used in this definition is considered to be HMA.

Stone Matrix Asphalt (SMA)

SMA is hot mixed asphalt with a gap graded aggregate gradation and a mastic fine aggregate fraction.

Full-Depth Reclamation and Overlay

Full-depth reclamation and overlay is done by completely grinding up the existing pavement and base course at ambient temperatures to the subgrade. This ground up mixture is then compacted and a hot mixed asphalt pavement is placed on top.

Heater Scarification and Overlay

Heater scarification and overlay begins with the process of heating up the pavement, using teeth to scarify the pavement, and then spraying a rejuvenating agent on the scarified surface. The rejuvenating agent and the scarified asphalt pavement are mixed together and the resulting material is leveled using a screed. After this rejuvenated material is leveled and compacted a hot mixed asphalt wearing course is placed.

Heater Remix and Overlay

The heater remix and overlay process is done by heating the pavement and using a cutting drum to mill the existing surface to a depth of between 1.5 inches to 2 inches. The aggregate gathered from the milling has a rejuvenating agent added and then the HMA is added. All of this material is brought into a hopper and mixed together to form a single mix. The mixture is then spread out and compacted.

Heater Repaving and Overlay

With this process the pavement is heated, scarified and a rejuvenating agent is added to the scarified material before it is mixed and leveled. Immediately after this process is

performed, a layer of HMA is placed over the heated recycled surface. A screed is used to level the pavement and everything is compacted. Scarification is usually between 0.75 inches to 1.5 inches deep. This process helps to form a strong bond between the two layers of pavement.

Cold In-Place Recycling and Overlay

Cold in-place recycling and overlay involves the process of removing the surface of the existing pavement by grinding at ambient temperatures. This material is screened, crushed, and mixed with emulsified asphalt, then placed with conventional paving equipment and compacted. This process is all done in one continuous operation from grinding to laydown. After the compaction, and some curing, a hot mixed asphalt overlay is placed.

1.2 Scope and Goals of Research

The goal of this research is to determine the performance of eight rehabilitation strategies utilized by CDOT. The objectives were:

- Determine the average amount of distress per year;
- Determine the condition of the pavements prior to rehabilitation;
- Determine the rate of deterioration per year;
- Determine the coefficient of determination of the regression equations derived;
- Determine the average amount of highway segments used per year;
- Determine which rehabilitation strategies perform best under various conditions;
and
- Provide instructions for updating the data in this study.

Independent variables evaluated for each of the rehabilitation strategies were:

- Polymer modified (PG range >90 °C) vs. non-polymer modified (PG range <90 °C);
- Traffic volume;
- National Highway System classification ;

- Hot mix aggregate gradation;
- CDOT Region; and
- Climate.

Polymer Modified

Asphalts used in hot mixed asphalt in Colorado are graded according to the Superpave PG system. When the range of temperatures specified by this system is greater than 90 °C, the asphalt is generally considered to require modification by polymers. When this temperature range is less than 90 °C, the asphalt is generally considered to be a straight run petroleum asphalt without polymer modification.

Traffic Volume

The highways are split into three different traffic volumes based on 20-year, 18 kip equivalent single axle loads (ESALs):

- Low Traffic < 0.3 million ESALs;
- Moderate Traffic 0.3 to 11 million ESALs; and
- High Traffic > 11 million ESALs.

National Highway System

There are two different highway classifications for the purpose of this study. A highway that is classified as NHS is a highway that is listed on the National Highway System and one that is classified as non-NHS is classified as not on the National Highway System. The National Highway System (NHS) is a system of highways around the country that have been determined to be high priority routes. Highways classified as NHS are likely to get funding from the federal government for improvements and new construction. The NHS was enacted to make sure that the major arterials of our nation were being maintained and in good working condition. Figure 1 is a map of the NHS in Colorado.

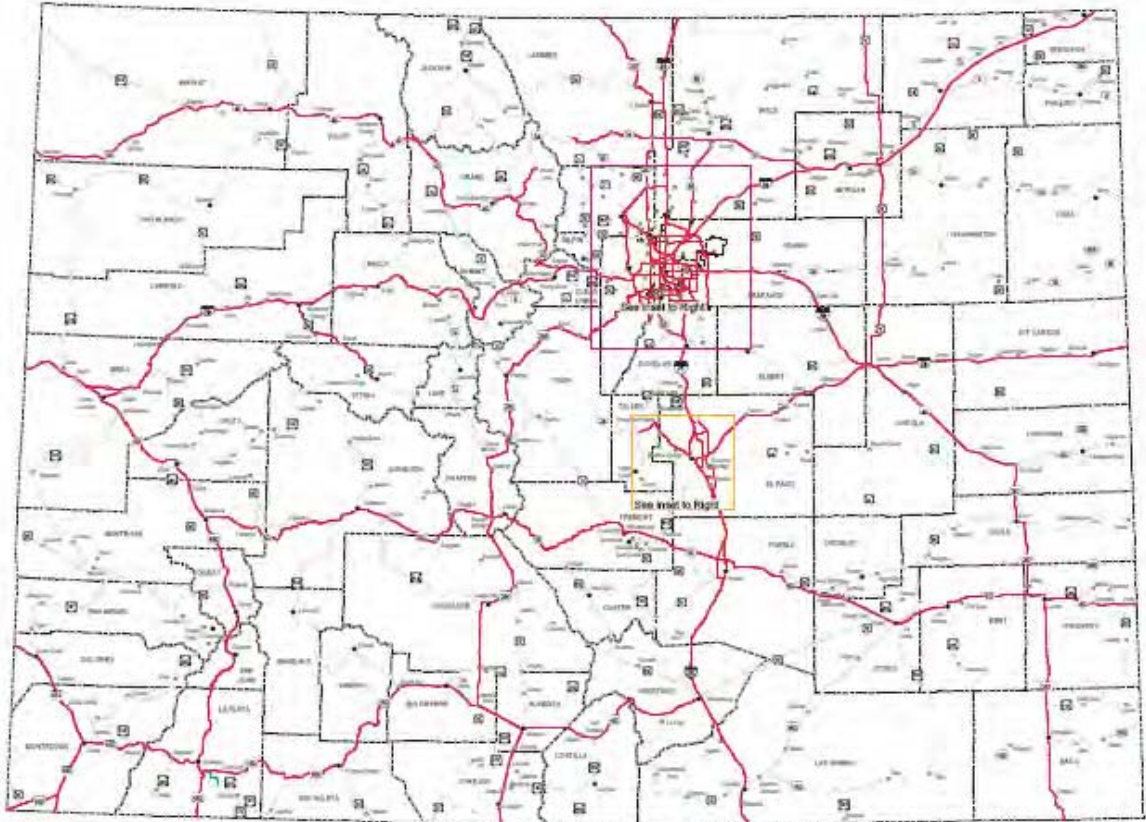


Figure 1 National Highway System in Colorado

Hot Mix Aggregate Gradation

Two hot mix aggregate gradations were evaluated in this study. The ‘S’ gradation has a nominal maximum aggregate size of 1 inch. The ‘SX’ gradation has a nominal maximum aggregate size of ¾ inch.

CDOT Regions

The Colorado Department of Transportation divides the state into six engineering regions as shown in Figure 2.

Climates

The environments in the state of Colorado are broken down into four different zones: a very cool environment has an average high air temperature of less than 81 °F, a cool environment with a average high air temperature between 81 – 88 °F, a moderate environment that has an average high air temperature between 88 – 97 °F, and a hot

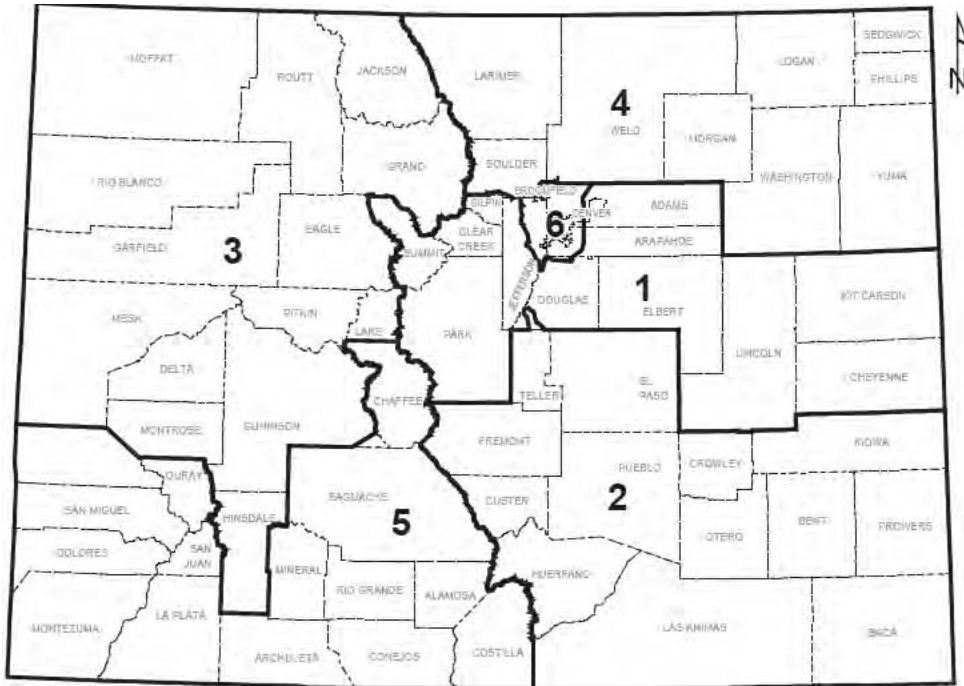


Figure 2 CDOT Engineering Regions

environment that has an average high air temperature of greater than 97 °F (Goldbaum 2008).

The rate of change for each of the criteria below will be evaluated for each rehabilitation strategy and each independent variable described above.

- Smoothness
- Rutting
- Fatigue
- Transverse Cracking
- Longitudinal Cracking

2.0 LITERATURE REVIEW

Throughout the years, there have been many studies conducted on pavement management, materials testing, and pavement costs in different parts of the United States. Some of these studies were done in a laboratory setting while some were administered using test strips on actual highways. Good management is vital to the longevity of pavement. Testing of practical types of rehabilitation techniques used in various environments and situations is part of building a successful pavement management plan. Actual test strips using real traffic patterns have been used to better understand how a pavement rehabilitation plan works best under different circumstances. Many state agencies have tested various materials used in their state for the effectiveness both in regards to cost and performance. Methodologies for testing and building performance curves vary between studies.

2.1 Texas Study

A study conducted by the Texas Department of Transportation (TxDOT) hypothesized that concrete pavements with HMA overlays prolong the life of a pavement (Chen, Scullion & Bilyeu, 2006).

In Texas, currently 2% of their state-maintained road system is jointed concrete pavement. TxDOT built a number of test sections around the state to improve the quality of the pavement after rehabilitation (Chen, Scullion & Bilyeu, 2006). The biggest issue with jointed concrete is the tendency to have reflective cracking, which can impact the structural integrity of a pavement because of the tendency of moisture to deposit in the cracks in the pavement (Chen, Scullion & Bilyeu, 2006). In the colder months, water deposited in the cracks can enter a freeze-thaw cycle and damage the pavement dramatically. The State of Texas was involved in testing various methods to help with the problem over the years, but the results of those methods have varied greatly (Chen, Scullion & Bilyeu, 2006).

The treatment methods tested by TxDOT included:

- Crack-retarding grid;
- Crack-retarding asphalt layer;
- Petromat fabric underseal;
- Crumb rubber modified asphalt;
- Flexible base; and
- Arkansas mix.

TxDOT expects their pavements to last at least eight years after the rehabilitation is performed. The study found that some pavements did not perform to the eight-year expectancy and had to be replaced within one year (Chen, Scullion & Bilyeu, 2006).

One flaw with the experiment was that the integrity of the test strips could have been compromised because the test strips were short sections of highway. The majority of the contractors were set up to do longer sections of highway. This could potentially have an impact on the quality of the pavements placed (Chen, Scullion & Bilyeu, 2006).

All six of the methods were tested on various test strips throughout the state and the distresses were measured annually. Sections of the test strips were removed and used as samples that were taken to a laboratory and analyzed (Chen, Scullion & Bilyeu, 2006). No performance measures were given in the study. It was concluded that the crack-retarding grid performance was disappointing because of the relationship between it and premature failures (Chen, Scullion & Bilyeu, 2006). Both the Arkansas mix and flexible base performed well. Joint movement was slowed when using a flexible base. Reflective cracking was also slowed when a flexible base was used. When petromatic fabric was used, reflective cracking was shown to have slowed (Chen, Scullion & Bilyeu, 2006). Strata, which is an asphalt-rich polymer modified binder and fine aggregate hot mix (Chen, Scullion, & Bilyeu, 2006), also has shown good performance. Break-and-seat sections showed disappointing results, mostly due to a weak sub grade (Chen, Scullion & Bilyeu, 2006).

2.2 Pennsylvania Study

In another study, Morian and Cumberledge evaluated techniques for selecting correct pavement rehabilitation strategies in Pennsylvania. They identified the important information for analyzing the best rehabilitation techniques to use in their state. They claim that understanding the project's history is most important. A thorough assessment of traffic history, evaluation of materials used, general understanding of past construction practices, history of climate, and an understanding of the type of subgrade are also important to know, when analyzing the performance of different rehabilitation techniques (Morian & Cumberledge, 1997).

Steps are also given that address how to choose the most cost effective rehabilitation technique. These steps include: evaluate the existing pavement distress, determine cause of distress, and consider multiple techniques to address distress, evaluate effectiveness of other techniques, and then determine what technique will prove to be the most cost effective (Morian & Cumberledge, 1997). Matrices and performance curves are built from data and used as a tool for selecting the proper technique to use on a given section of highway (Morian & Cumberledge, 1997).

Pennsylvania's Overall Pavement Index (OPI) was used to provide data. The OPI is designed to reflect the overall condition of the pavements and includes using four indexes: ride index, structural index, surface distress index, and safety index. Each index has a weight assigned to it to make up the overall pavement index. Ride index is a measurement from the International Roughness Index. Structural index is a combination of cracking, joint failing, broken pavements, and surface defects. Surface distress index is comprised of seal failures, transverse cracking, rutting, surface defects, and joint spalling. Safety index includes joint spalling, transverse cracking, faulting, broken pavements, patching, surface defects, rutting, and shoulder drop-off. Each item included in the indexes is given a weight of the total index and thus some items are included in one or more indexes (Morian & Cumberledge, 1997).

Measurements are taken from the highway and then organized and plotted on graphs. Graphs show the distress versus time and that over time distresses tend to get worse. A case study that included the analysis of a cold in-place recycling of asphalt was conducted for the study over a twelve year period. It was determined that the pavements tended to perform as expected (Morian & Cumberledge, 1997).

2.3 Nevada Study

In another study by the Nevada Department of Transportation (NDOT), a network optimization system (NOS) was developed. This system is used to evaluate alternate rehabilitation techniques and then recommend the most efficient and cost effective technique for different sections of highway (Hand, Sebaaly & Epps, 1999).

Present serviceability index (PSI) is the performance measure that was used by NDOT to measure amounts of distresses. PSI is a calculation of rut depth, slope variances, cracking, and patching. Performance models were developed from the PSI numbers for the overlay and the mill/overlay rehabilitation techniques used. (Hand, Sebaaly, & Epps, 1999). Projects were selected around the state to be used in the study. Three restrictions were used when choosing sections: a minimum number of replicated sections, a minimum project length of three kilometers, and only projects with enough quality data were chosen (Hand, Sebaaly & Epps, 1999).

The data used to build the performance curves was gathered from NDOT's pavement management system and other historical databases NDOT has on file. Data from the pavement management system is organized by direction of lane mile. Box plots were then used to plot the data on a graph to show the percentage of allowable distress over time (Hand, Sebaaly & Epps, 1999).

Data was separated into different segments around the state. Segments were chosen from similar highways for analysis reasons. Beginning and ending milepost, existing

pavement structure, existing structural number, traffic loads, and environmental conditions are also included in the database (Hand, Sebaaly & Epps, 1999).

Linear regression analysis was used to develop performance models for overlay and mill/overlay rehabilitation treatments. PSI was used as a measurement of performance, and models were developed as this measurement relates to pavement age, traffic loads, material properties, and environmental conditions (Hand, Sebaaly & Epps, 1999). No performance models were included in the study. A generic process was explained to create performance models for rehabilitation strategies.

A large database is needed in order to build accurate performance curves for different sites in Nevada. Engineering and good judgments must be used to build good performance models. The user of the system must also have an understanding of the way the system works so that the limitations are known (Hand, Sebaaly & Epps, 1999).

3.0 METHODOLOGY

Data analyzed in this study was obtained from the pavement management database of the Colorado Department of Transportation. This database houses the results of pavement condition surveys collected annually by automated photo survey and laser profilometer equipment. Data has been collected and stored in the database using this technology since 1999. Data from 1999 to 2006 were analyzed in this study. Pavement condition is recorded in increments of 0.10 mile for various lengths of highway ranging from one to six miles. Each of these 0.10-mile increments represents a data point. The condition of each roadway was represented by calculating a moving average from five of these data points for the length of roadway evaluated each year. The change in condition was then determined by comparing the average of the moving averages from year to year. The example shown in Table 1 indicates an increase in roughness of 36.5 in/mi from 1998 to 1999 for the roadway shown.

Both asphalt and concrete pavement distresses are measured in 0.10 mile increments showing the direction of travel. Highways are classified as either being located on the National Highway System (NHS) or not being located on the National Highway System (non-NHS).

The first step was to search the databases for distress data from 1999 to 2006 and transfer the eight years of data into an Excel database. This database was used to organize the data into the separate highway sections and years. Other spreadsheets/databases were produced for each of the different pavement rehabilitation strategies shown in Table 1.

Table 1 Numbers of Segments for Each Rehabilitation Strategy

| Type of Rehabilitation | | # of Segments |
|------------------------|--|---------------|
| 1 | Cold Planing and Overlay | 57 |
| 2 | Two to Four Inch Overlay | 73 |
| 3 | Stone Matrix Asphalt (SMA) Overlay | 5 |
| 4 | Full Depth Reclamation (FDR) and Overlay | 6 |
| 5 | Heater Scarification and Overlay | 19 |
| 6 | Heater Remix and Overlay | 6 |
| 7 | Heater Repaving and Overlay | 4 |
| 8 | Cold Recycle and Overlay | 5 |
| Total | | 175 |

After the data sets were organized by year and rehabilitation techniques, the moving average for every 0.50 mile was calculated for each of the highway segments. The highways were also organized by direction or travel. This eliminates directional factors affecting results. The maximum moving average for each direction was calculated. This process was done for all 175 highways for eight years.

Data were then organized into highway segments and years. A summary sheet was provided for each year sorted by highway segment, which shows the maximum moving average for each highway segment and year. The data were then broken down into six separate criteria of interest to CDOT. These criteria are outlined in Figure 3.

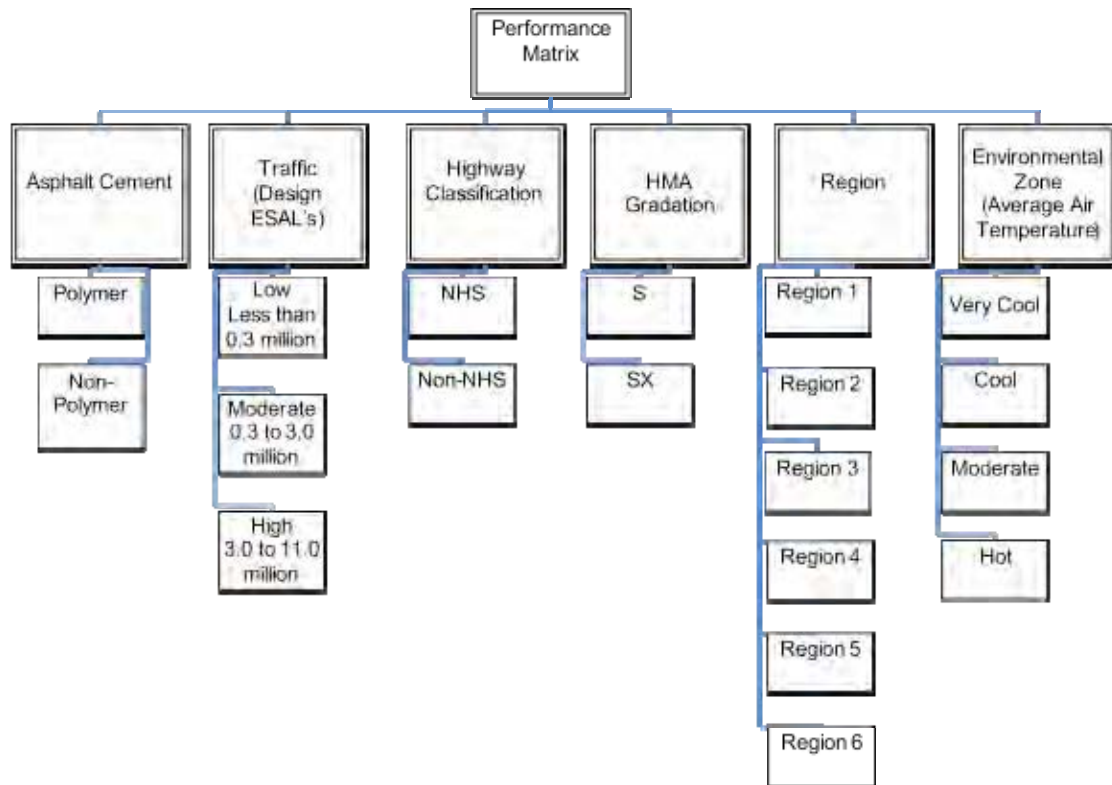


Figure 3 Independent variables

A summary sheet was created for each of the eight rehabilitation strategies.

After the highway sections were analyzed, using each of the six criteria, a slope for a distress versus time curve was calculated for each of the highway segments. Two guidelines were established in order to decide to accept or reject the data from the segment. The first guideline was that the regression equation should have a coefficient of determination (R-squared value) of greater than 0.50, which is a guideline already in use by CDOT for other projects. The second guideline was that no negative slopes would be used for the analysis. A negative slope means that the pavement was correcting itself, or getting better over time.

After data were sorted, the average level of distress was calculated for each year. This was then used to calculate the slope of deterioration from year to year. The cumulative slope of deterioration could then be calculated and graphed for each of the 19 separate criteria times 5 distresses per criteria = 95 graphs plus 5 graphs showing the behavior of

each distress without application of variables. A robust statistical analysis was not possible for all combinations and permutations due to a lack of data. Instead trend analysis was used to show how the rehabilitation methods affected performance of the pavements over time.

Tables are also provided showing the change in deterioration over time, the coefficient of determination, and the average number of samples used to obtain these statistics.

3.1 Data Analysis

An example is provided below to show how the data was analyzed in this study. Table 2 is an example of roadway smoothness data for the years 1998 and 1999.

Table 2 Calculating Average Roadway Condition with Time

| Survey Date: 1998 | | | | Survey Date: 1999 | | | |
|-------------------|-----------|------------|----------------|-------------------|------|-----|----------------|
| Begin MP | Ending MP | IRI, in/mi | Avg IRI, in/mi | BMP | EMP | IRI | Avg IRI, in/mi |
| 95.5 | 95.6 | 123 | | 95.5 | 95.6 | 94 | |
| 95.6 | 95.7 | 130 | | 95.6 | 95.7 | 87 | |
| 95.7 | 95.8 | 86 | | 95.7 | 95.8 | 130 | |
| 95.8 | 95.9 | 130 | | 95.8 | 95.9 | 179 | |
| 95.9 | 96 | 138 | 121.4 | 95.9 | 96 | 122 | 122.4 |
| 96 | 96.1 | 134 | 123.6 | 96 | 96.1 | 127 | 129 |
| 96 | 96.1 | 171 | 131.8 | 96 | 96.1 | 112 | 134 |
| 96.1 | 96.2 | 94 | 133.4 | 96.1 | 96.2 | 167 | 141.4 |
| 96.2 | 96.3 | 93 | 126 | 96.2 | 96.3 | 178 | 141.2 |
| 96.3 | 96.4 | 212 | 140.8 | 96.3 | 96.4 | 198 | 156.4 |
| 96.4 | 96.5 | 49 | 123.8 | 96.4 | 96.5 | 80 | 147 |
| 96.5 | 96.6 | 80 | 105.6 | 96.5 | 96.6 | 249 | 174.4 |
| 96.6 | 96.7 | 91 | 105 | 96.6 | 96.7 | 109 | 162.8 |
| 96.7 | 96.8 | 91 | 104.6 | 96.7 | 96.8 | 100 | 147.2 |
| 96.8 | 96.9 | 44 | 71 | 96.8 | 96.9 | 290 | 165.6 |
| 96.9 | 97 | 82 | 77.6 | 96.9 | 97 | 157 | 181 |
| | | | Avg > | | | | Avg > |
| | | | 113.7 | | | | 150.2 |

Each roadway in the study was evaluated this way for each year of condition surveys.

A total of 149 roadways were evaluated in this study separated by the three rehabilitation methods as shown in Table 3.

Table 3 Rehabilitation Methods for Roadways Studied

| Rehabilitation Method | Roadways Studied |
|----------------------------------|-------------------------|
| Two Inch Overlay | 73 |
| Cold Planing and Overlay | 57 |
| Heater Scarification and Overlay | 19 |
| Total | 149 |

3.1.1 Data Reduction

The analysis was done from one year prior to rehabilitation to six years after rehabilitation. This way, the condition of the pavements prior to rehabilitation could be captured in the analysis so that the amount of time required to return the pavements to pre-rehabilitation condition could be determined. This allows calculating the service length of each of the rehabilitation strategies. That is, if a pavement had 500 square feet of fatigue cracking at the time of rehabilitation and fatigue cracking reappears after rehabilitation at the rate of 100 square feet per year, then it will take five years for the pavement to return to the pre-rehabilitated condition with respect to fatigue cracking.

An example is provided below to demonstrate how the data was analyzed.

Data shown in Table 4 represent eighteen roadways with smoothness data reported for the cold planing and overlay rehabilitation strategy.

Table 4 Smoothness Analysis for Planing and Overlay, IRI, in/mi

| Roadway | Year (0) | Year (+1) |
|----------------|-----------------|------------------|
| 1 | 146.6 | 157.8 |
| 2 | 74.0 | 119.8 |
| 3 | 115.6 | 118.0 |
| 4 | 120.0 | 93.4 |
| 5 | 91.0 | 100.6 |
| 6 | 95.2 | 85.8 |
| 7 | 68.6 | 80.8 |
| 8 | 71.0 | 111.6 |
| 9 | 77.4 | 110.6 |
| 10 | 61.6 | 113.8 |
| 11 | 113.6 | 128.8 |
| 12 | 136.4 | 132.0 |
| 13 | 68.0 | 112.0 |
| 14 | 116.8 | 132.0 |

| | | |
|----------------|--------------|--------------|
| 15 | 100.0 | 85.0 |
| 16 | 98.0 | 107.8 |
| 17 | 213.0 | 176.0 |
| 18 | 81.8 | 86.0 |
| Average | 102.7 | 114.0 |

The average change in smoothness from Year +1 to Year 0 is (114.0 in/mile - 102.7 in/mile) = 11.3 in/mi. When the data for each year from +1 to +6 are analyzed this way, the results shown in Table 5 are obtained..

Table 5 Change in Smoothness Each Year for Planing and Overlay Projects

| Year | Smoothness Change, inches/mile/year |
|--------|--|
| 0 to 1 | 11.3 |
| 1 to 2 | 6.3 |
| 2 to 3 | 10.2 |
| 3 to 4 | 7.7 |
| 4 to 5 | 3.3 |
| 5 to 6 | 15.6 |

The cumulative change in smoothness with time can then be determined as shown in Table 6.

Table 6 Cumulative Smoothness Change for Planing and Overlay Projects

| Year | Smoothness Change, inches/mile/year (from Table 3) | Cumulative Smoothness Change, inches/mile/year |
|------|--|---|
| 0 | 0 | 0 |
| 1 | 11.3 | 11.3 |
| 2 | 6.3 | 17.6 |
| 3 | 10.2 | 27.8 |
| 4 | 7.7 | 35.5 |
| 5 | 3.3 | 38.8 |
| 6 | 15.6 | 54.4 |

If the cumulative smoothness change is regressed linearly from Year 0 to Year 6, the result is:

$$\Delta \text{IRI} = 8.42 T$$

Where,

$$\begin{aligned} \Delta \text{IRI} &= \text{Change in IRI in inches per mile} \\ T &= \text{Time after rehabilitation, yrs} \end{aligned}$$

The same analysis was done for each of the other rehabilitation methods with respect to smoothness resulting in the following expressions when all projects are considered:

$$\text{Overlay} \quad \Delta \text{IRI} = 8.20 T$$

$$\text{Cold Planing} \quad \Delta \text{IRI} = 8.42 T$$

$$\text{Heater Scarification} \quad \Delta \text{IRI} = 14.59 T$$

Therefore, based on this data, the IRI for heater scarification increases 1.78 times (14.59/8.20) faster compared with the IRI for the overlay rehabilitation method.

This analysis was also done for the other performance output variables for each rehabilitation method. The results are shown in Table 7 for all projects which include information on coefficient of determination and number of projects utilized in the regression.

Zero-Remaining Service Life (ZRSL) is the point at which the level of distress present in the roadway exceeds what is considered acceptable. Those values are shown below and will be indicated on the performance curves as bold horizontal lines to provide a baseline when the pavements were actually rehabilitated with respect to ZRSL.

- Smoothness, IRI 300 inches/mile
- Rutting 0.55 inches
- Fatigue 1,800 square feet
- Transverse Cracking 55 cracks per 0.1 mile
- Longitudinal Cracking 1,400 linear feet

Table 7 Linear Regression for Change in Performance for First Six Years

| | | Slope | R ² | n, Avg |
|-----------------------|----------------------|--------|----------------|--------|
| Smoothness | Cold Planing | 8.42 | 0.82 | 16 |
| | Overlay | 8.20 | 0.81 | 28 |
| | Heater Scarification | 14.59 | 0.83 | 11 |
| | Average | 10.26 | | |
| Rutting | Cold Planing | 0.03 | 0.83 | 29 |
| | Overlay | 0.05 | 0.70 | 45 |
| | Heater Scarification | 0.06 | 0.79 | 10 |
| | Average | 0.04 | | |
| Fatigue Cracking | Cold Planing | 86.42 | 0.50 | 28 |
| | Overlay | 191.35 | 0.42 | 44 |
| | Heater Scarification | 241.37 | 0.65 | 10 |
| | Average | 171.49 | | |
| Transverse Cracking | Cold Planing | 2.38 | 0.71 | 40 |
| | Overlay | 3.72 | 0.64 | 57 |
| | Heater Scarification | 6.47 | 0.73 | 13 |
| | Average | 4.19 | | |
| Longitudinal Cracking | Cold Planing | 53.14 | 0.66 | 28 |
| | Overlay | 55.01 | 0.61 | 37 |
| | Heater Scarification | 96.79 | 0.68 | 10 |
| | Average | 68.31 | | |

4.0 RESULTS

All of the pavement performance data is represented in Figures 4 through 103 and Tables 8 through 107 for smoothness, rutting, fatigue, transverse, and longitudinal cracking with respect to each rehabilitation method. Each of these figures represents the absolute value of the respective performance measure with the exception of smoothness, which is represented as the change in smoothness over time. This was done because the absolute value for smoothness is the only parameter that does not start from zero after rehabilitation. When data variability in the pavement management database resulted in a coefficient of determination less than 0.50 or when distress decreased with time, this data was not included in the analysis.

The rate of change of distress over time represented in the tables and figures has been calculated as a linear function. The average number of highway segments (n) which

contributed to these statistics is also shown to provide an indication of analysis robustness.

Year 0 (zero) in the graphs is the time of rehabilitation. Year -1 (negative 1) represents the condition of the pavements one year prior to rehabilitation. The condition of the pavements is presented at Year -1 to show the level of deterioration prior to rehabilitation. This is important when calculating the service length of each of the rehabilitation strategies. That is, if a pavement had 500 square feet of fatigue cracking at the time of rehabilitation and fatigue cracking re-appears after rehabilitation at the rate of 100 square feet per year, then it will take five years for the pavement to return to the pre-rehabilitated condition with respect to fatigue cracking.

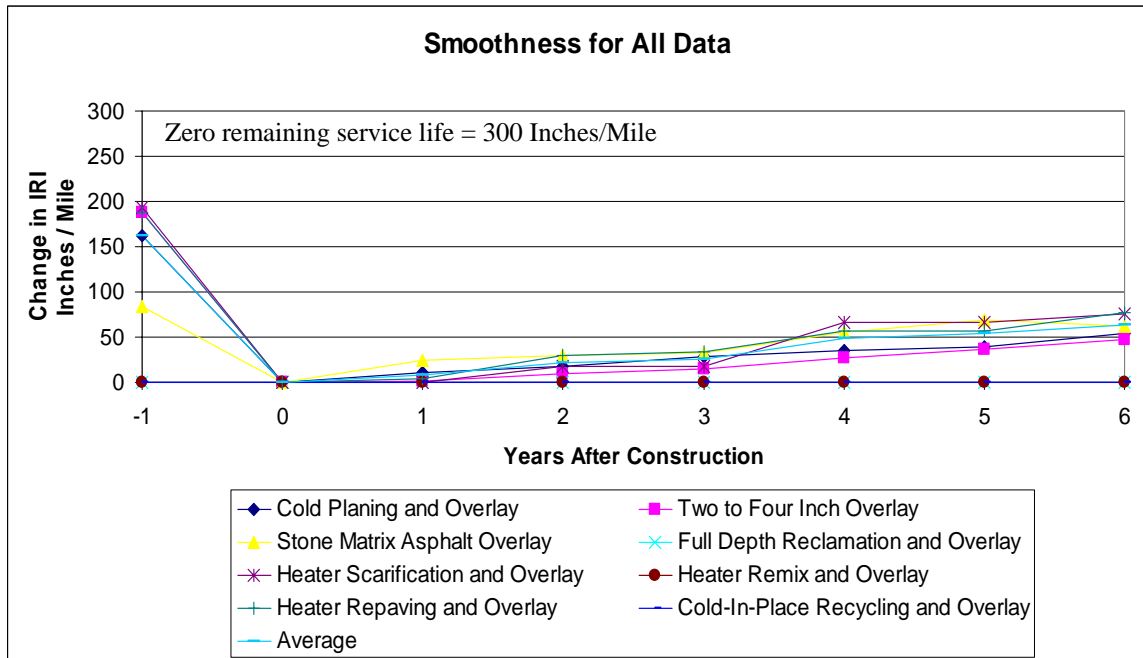


Figure 4 Rate of change for smoothness after six years all data included

Table 8 Smoothness Performance – All Data

| Treatment | Year | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|-------|-------|-------|-------|-------|-------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 162.21 | 0 | 11.30 | 17.56 | 27.73 | 35.44 | 38.76 | 54.32 | 8.4203 | 0.816 | 16.29 |
| Two to Four Inch Overlay | 187.2889 | 0 | 0.72 | 9.76 | 15.45 | 27.63 | 35.97 | 47.04 | 8.195986 | 0.814 | 27.71 |
| Stone Matrix Asphalt Overlay | 83.6 | 0 | 24.31 | 30.35 | 32.57 | 56.03 | 69.40 | 61.93 | 10.77405 | 0.903 | 4.43 |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 193.36 | 0 | - | 18.21 | 18.21 | 66.09 | 66.66 | 75.79 | 14.59141 | 0.832 | 10.86 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | 187.3 | 0 | 4.00 | 30.07 | 33.13 | 57.20 | 57.20 | 77.33 | 13.05476 | 0.912 | 2.86 |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 162.75 | 0 | 8.06 | 21.19 | 25.42 | 48.48 | 53.60 | 63.28 | 11.0073 | | |

Smoothness

The three rehabilitation strategies that did not meet the predetermined criteria are full depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay. Two to 4-inch overlay and cold planing and overlay had better smoothness than the other rehabilitation strategies. Heater scarification and overlay had the worst smoothness data.

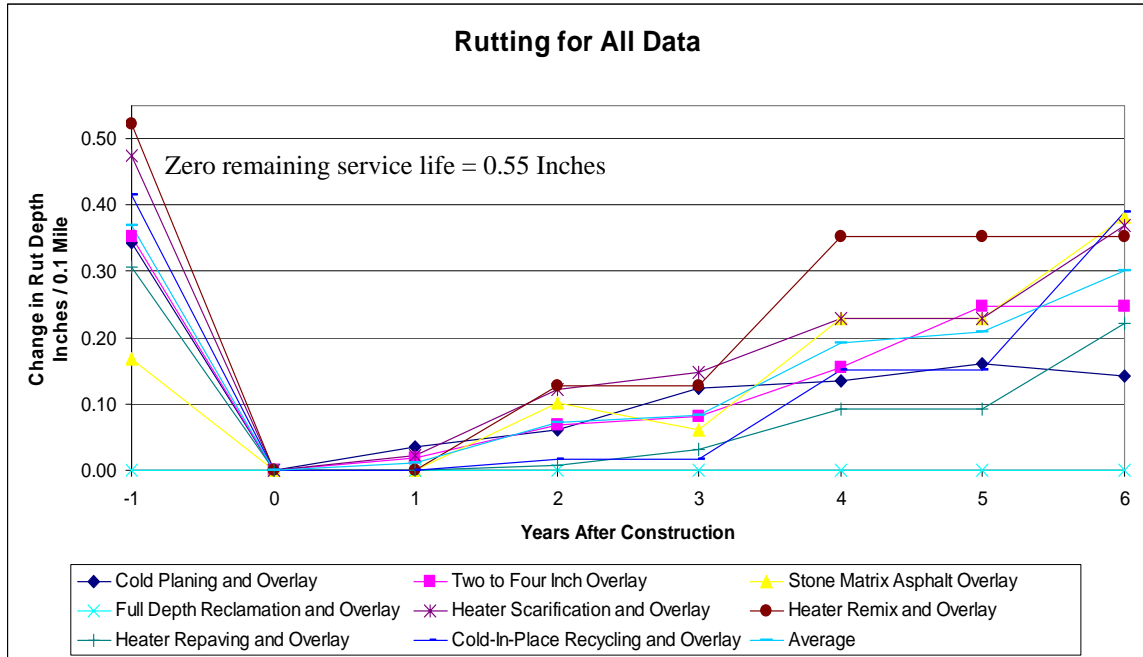


Figure 5 Permanent deformation performance after six years all data included

Table 9 Rutting Performance – All Data

| Treatment | Year | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|---|-------|-------|-------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 0.34 | 0 | 0.03 | 0.06 | 0.12 | 0.13 | 0.16 | 0.14 | 0.026824 | 0.831 | 29 | |
| Two to Four Inch Overlay | 0.351744 | 0 | 0.02 | 0.07 | 0.08 | 0.15 | 0.25 | 0.25 | 0.045873 | 0.698 | 44.57 | |
| Stone Matrix Asphalt Overlay | 0.1675 | 0 | - | 0.10 | 0.06 | 0.23 | 0.23 | 0.38 | 0.061821 | 0.909 | 3.57 | |
| Full Depth Reclamation and Overlay | - | - | - | - | - | - | - | - | - | - | - | |
| Heater Scarification and Overlay | 0.474444 | 0 | 0.02 | 0.12 | 0.15 | 0.23 | 0.23 | 0.37 | 0.058148 | 0.787 | 10.43 | |
| Heater Remix and Overlay | 0.521667 | 0 | - | 0.13 | 0.13 | 0.35 | 0.35 | 0.35 | 0.070833 | 0.838 | 3.71 | |
| Heater Repaving and Overlay | 0.307 | 0 | - | 0.01 | 0.03 | 0.09 | 0.09 | 0.22 | 0.033429 | 0.936 | 2.86 | |
| Cold-In-Place Recycling and Overlay | 0.4155 | 0 | - | 0.02 | 0.02 | 0.15 | 0.15 | 0.39 | 0.057375 | 0.908 | 3 | |
| Average | 0.322547 | 0 | 0.009 | 0.063 | 0.073 | 0.168 | 0.183 | 0.263 | 0.044288 | | | |

Rutting

Full depth reclamation and overlay is the only rehabilitation strategy that did not have enough samples to be analyzed. Cold planing and overlay had the best performance over time than any other rehabilitation strategy. The other rehabilitation strategies performed similarly.

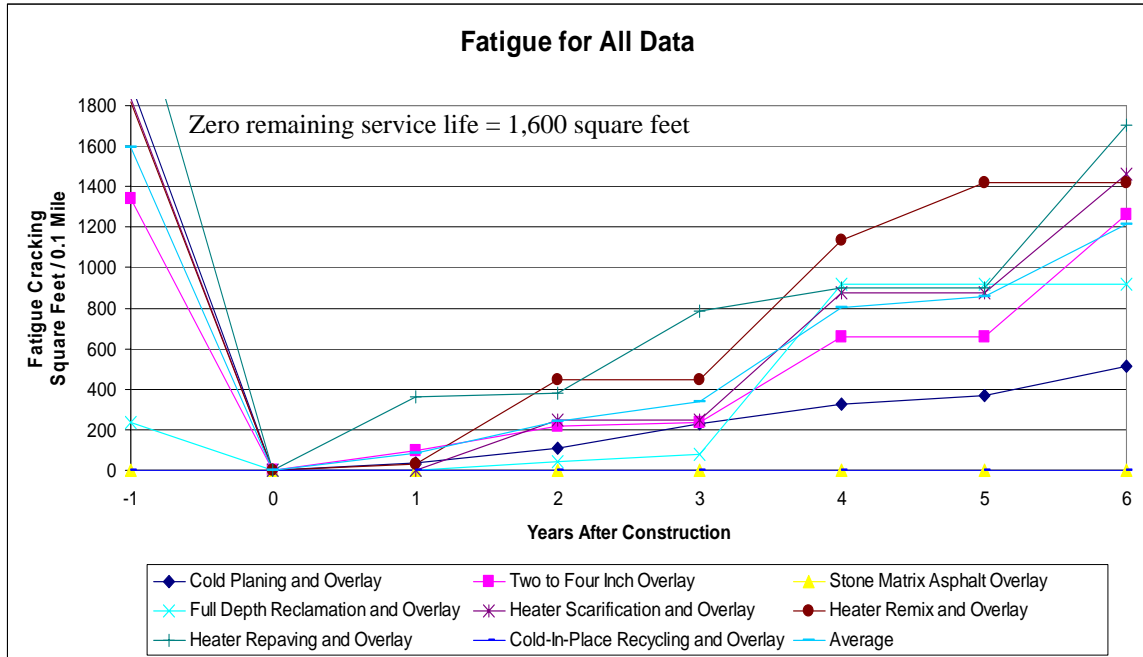


Figure 6 Fatigue cracking performance after six years all data included

Table 10 Fatigue Performance – All Data

| Treatment | Year | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|---|----------|----------|---------|-------------|-----------|-------------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 1907.81 | 0 | 36.44 | 111.19 | 230.64 | 327.59 | 366.22 | 514.56 | 86.41586 | 0.499 | 27.86 | |
| Two to Four Inch Overlay | 1339.005 | 0 | 94.15 | 214.48 | 233.78 | 657.95 | 657.95 | 1,262.22 | 191.3479 | 0.416 | 43.71 | |
| Stone Matrix Asphalt Overlay | - | - | - | - | - | - | - | - | - | - | - | |
| Full Depth Reclamation and Overlay | 234.8 | 0 | - | 41.36 | 80.04 | 917.24 | 917.24 | 917.24 | 195.0743 | 0.202 | 4 | |
| Heater Scarification and Overlay | 1833.6 | 0 | - | 250.50 | 250.50 | 875.74 | 875.74 | 1,460.54 | 241.3692 | 0.646 | 10 | |
| Heater Remix and Overlay | 1816.76 | 0 | 31.17 | 448.73 | 448.73 | 1,135.48 | 1,419.46 | 1,419.46 | 275.7748 | 0.57 | 5.43 | |
| Heater Repaving and Overlay | 2429.1 | 0 | 361.45 | 377.60 | 783.00 | 899.35 | 899.35 | 1,702.05 | 239.4179 | 0.697 | 3.71 | |
| Cold-In-Place Recycling and Overlay | - | - | - | - | - | - | - | - | - | - | - | |
| Average | 1195.134 | 0 | 65.40034 | 180.4829 | 253.337 | 601.6674556 | 641.99393 | 909.5092397 | 153.675 | - | - | |

Fatigue

Both stone matrix asphalt overlay and cold-in-place recycling and overlay did not meet the criteria and are not used in analysis. Cold planing and overlay showed at least half the amount of fatigue cracking over time than all of the other rehabilitation strategies.

Heater remix and overlay showed the most amount of fatigue cracking per year as shown in Figure 6 and Table 10.

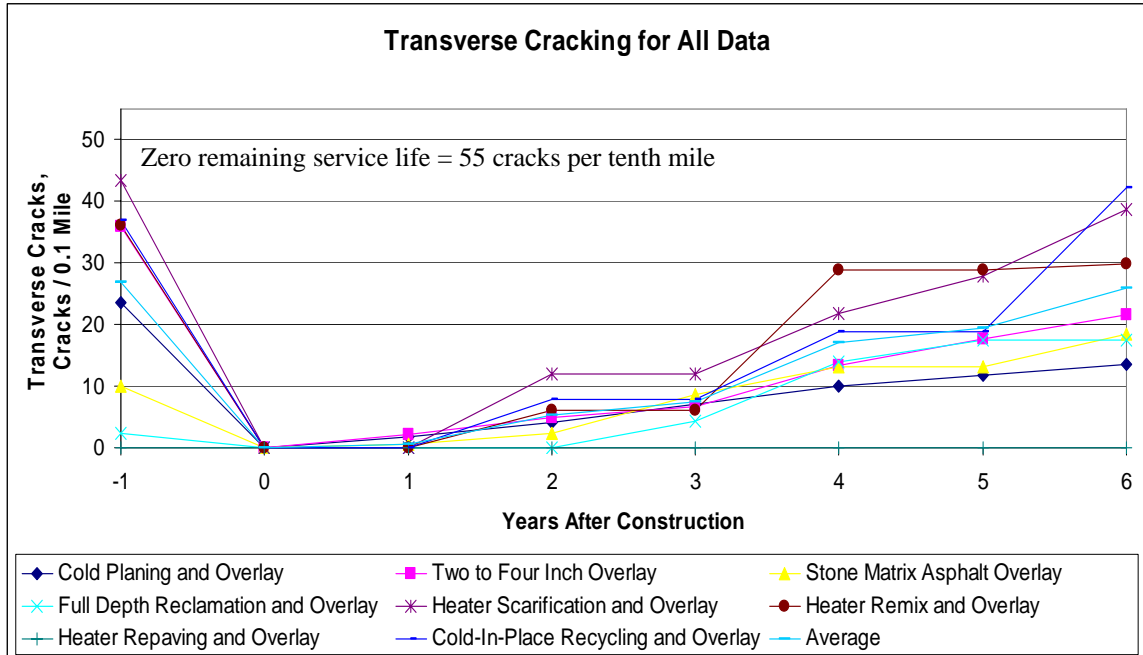


Figure 7 Transverse cracking performance after six years all data included

Table 11 Transverse Cracking Performance – All Data

| Treatment | Year | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|---|----------|----------|----------|----------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 23.65 | 0 | 1.78 | 4.06 | 7.13 | 9.93 | 11.86 | 13.49 | 2.375503 | 0.712 | 40.14 |
| Two to Four Inch Overlay | 36.02609 | 0 | 2.21 | 4.83 | 6.59 | 13.28 | 17.61 | 21.64 | 3.721093 | 0.635 | 57.29 |
| Stone Matrix Asphalt Overlay | 10.05 | 0 | 0.67 | 2.37 | 8.68 | 13.24 | 13.24 | 18.51 | 3.269286 | 0.601 | 4.43 |
| Full Depth Reclamation and Overlay | 2.4 | 0 | - | 0.10 | 4.35 | 13.99 | 17.50 | 17.50 | 3.62034 | 0.687 | 4.86 |
| Heater Scarification and Overlay | 43.36364 | 0 | 0.06 | 12.06 | 12.06 | 21.75 | 27.87 | 38.61 | 6.468827 | 0.733 | 12.71 |
| Heater Remix and Overlay | 36.13333 | 0 | - | 6.14 | 6.14 | 28.86 | 28.86 | 29.76 | 6.062117 | 0.597 | 6.14 |
| Heater Repaving and Overlay | - | - | - | - | - | - | - | - | - | - | - |
| Cold-In-Place Recycling and Overlay | 36.93333 | 0 | - | 7.93 | 7.93 | 18.93 | 18.93 | 42.33 | 6.280357 | 0.595 | 4.43 |
| Average | 23.57001 | 0 | 0.590227 | 4.683851 | 6.610384 | 14.99846 | 16.98403 | 22.72971 | 3.97469 | | |

Transverse Cracking

Heater repaving and overlay is the only rehabilitation strategy that did not have enough samples. Cold planing and overlay showed the least amount of transverse cracking per year than all other rehabilitation strategies. Both heater scarification and overlay and cold-in-place recycling and overlay showed the most amount transverse cracking per year.

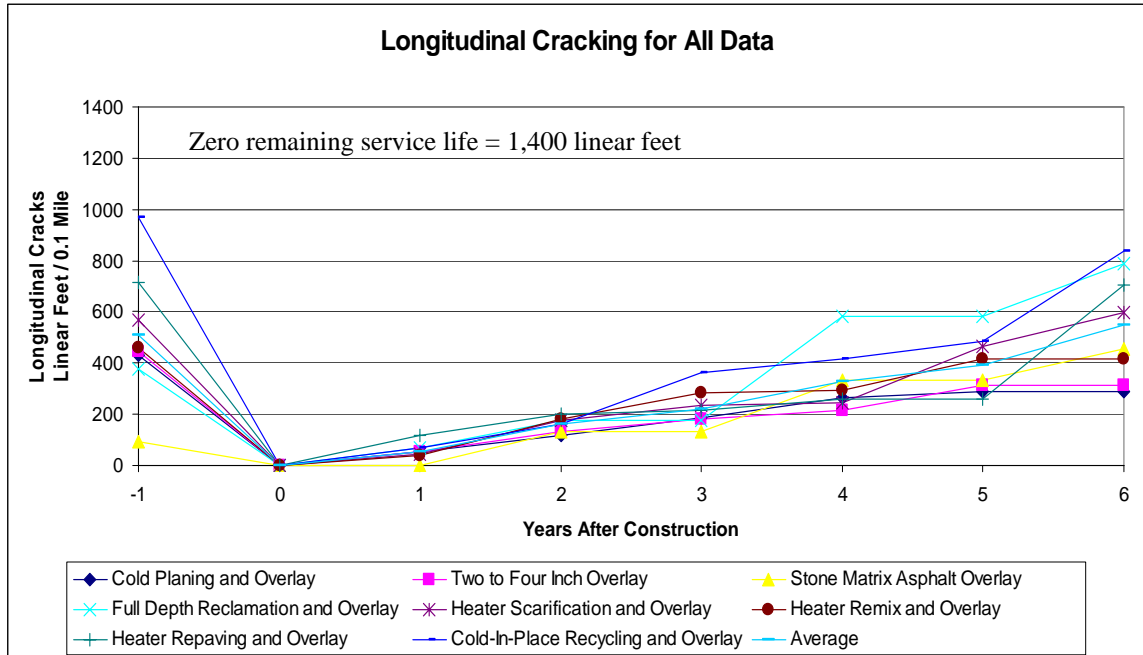


Figure 8 Longitudinal cracking performance after six years all data included

Table 12 Longitudinal Cracking Performance – All Data

| Treatment | Year | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|---|----------|----------|----------|----------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 432.48 | 0 | 52.96 | 119.66 | 186.79 | 262.42 | 290.82 | 289.85 | 53.14437 | 0.659 | 28 |
| Two to Four Inch Overlay | 446.8919 | 0 | 53.10 | 130.46 | 182.54 | 213.78 | 312.61 | 312.61 | 55.00615 | 0.609 | 36.71 |
| Stone Matrix Asphalt Overlay | 92.2 | 0 | 2.40 | 131.45 | 131.45 | 334.92 | 334.92 | 454.52 | 79.71607 | 0.571 | 2.71 |
| Full Depth Reclamation and Overlay | 378.8 | 0 | 66.63 | 177.96 | 177.96 | 584.41 | 584.41 | 789.41 | 136.0798 | 0.523 | 4.57 |
| Heater Scarification and Overlay | 568.3889 | 0 | 41.63 | 174.72 | 234.35 | 245.15 | 464.99 | 597.65 | 96.78978 | 0.679 | 10 |
| Heater Remix and Overlay | 462.44 | 0 | 39.46 | 183.37 | 282.15 | 293.40 | 415.33 | 415.33 | 75.27806 | 0.759 | 5.57 |
| Heater Repaving and Overlay | 716.4 | 0 | 115.10 | 199.05 | 214.50 | 261.65 | 261.65 | 705.45 | 88.2875 | 0.808 | 3.14 |
| Cold-In-Place Recycling and Overlay | 969.5333 | 0 | 70.46 | 160.44 | 360.56 | 414.48 | 483.36 | 836.11 | 128.1489 | 0.659 | 4.43 |
| Average | 508.3918 | 0 | 55.21782 | 159.6373 | 221.2873 | 326.2757 | 393.5115 | 550.1172 | 89.05633 | | |

Longitudinal Cracking

All rehabilitation strategies met the minimum number of samples per year. Cold planing and overlay and 2 to 4-inch overlay showed the least amount of longitudinal cracking per year. Full-depth reclamation and overlay had significantly more longitudinal cracking per year than all of the other rehabilitation strategies.

**CUMULATIVE INCREASE IN DISTRESS WITH RELATION TO POLYMER AND
NON-POLYMER MODIFIED OVERLAYS**

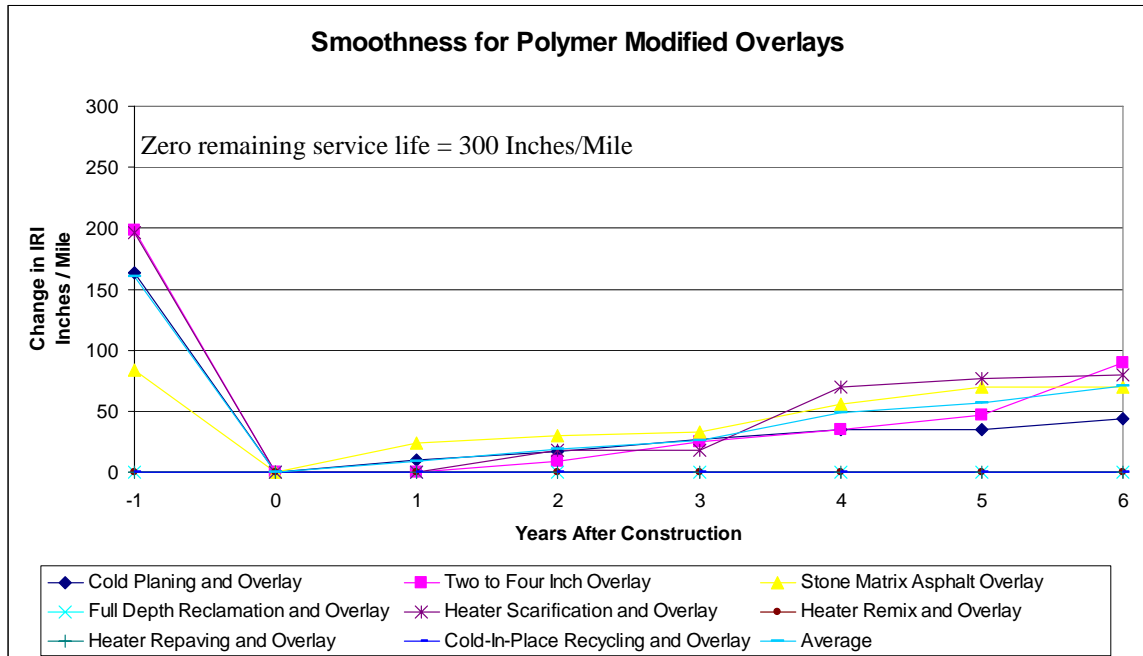


Figure 9 Rate of change for smoothness after six years with relation to polymer modified pavements

Table 13 Smoothness Performance – Polymer Data

| Treatment | POLYMER | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|---------|------|-------|-------|-------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 163.26 | 0.00 | 9.82 | 16.65 | 27.36 | 35.01 | 35.01 | 43.63 | 7.129555 | 0.786 | 9.71 | |
| Two to Four Inch Overlay | 198.5 | 0 | - | 9.17 | 24.97 | 34.43 | 47.02 | 89.92 | 13.89464 | 0.801 | 5.29 | |
| Stone Matrix Asphalt Overlay | 83.6 | 0 | 24.31 | 30.35 | 32.57 | 56.03 | 69.40 | 69.40 | 11.57405 | 0.903 | 4.43 | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 196.275 | 0 | - | 18.32 | 18.32 | 69.99 | 76.78 | 80.02 | 15.90362 | 0.838 | 9.57 | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 160 | 0 | 8.53 | 18.62 | 25.81 | 48.87 | 57.05 | 70.74 | 12.12547 | | | |

Smoothness - Polymer

Full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed better performance over time with regards to smoothness than other rehabilitation strategies. Heater scarification and overlay showed the worst performance over time. The other processes that met the predetermined criteria all performed similarly.

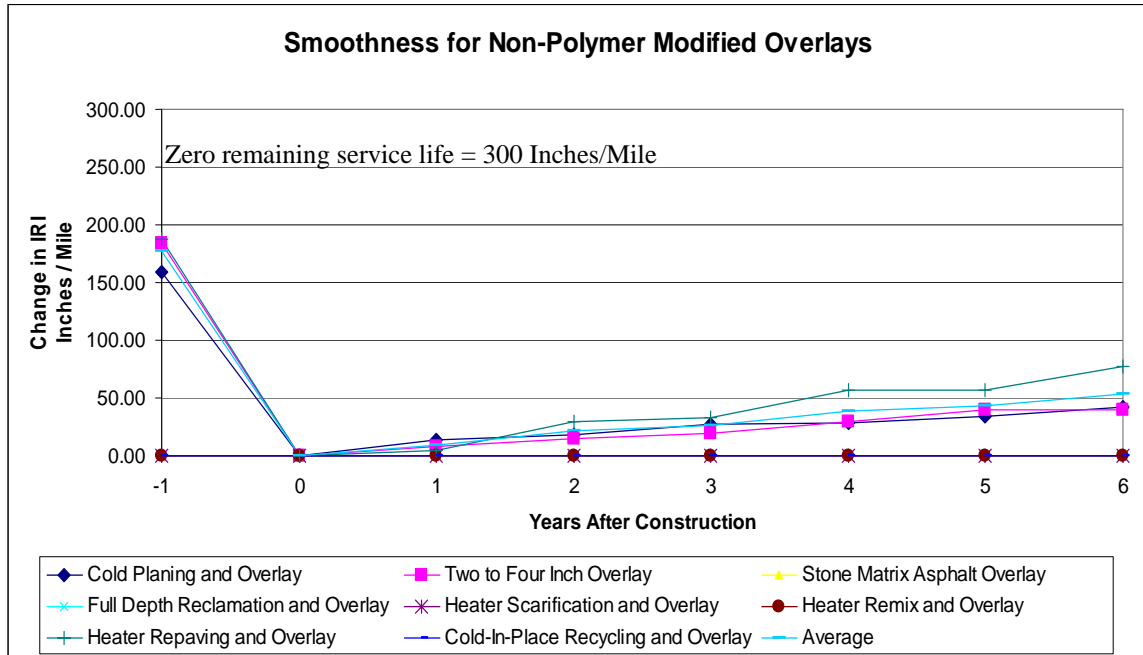


Figure 10 Rate of change for smoothness after six years with relation to non-polymer modified pavements

Table 14 Smoothness Performance –Non-Polymer Data

| Treatment | NON-POLYMER | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-------------|------|-------|-------|-------|-------|-------|-------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 159.60 | 0 | 14.08 | 18.64 | 27.12 | 28.76 | 33.56 | 42.52 | 6.308571 | 0.832 | 4.57 |
| Two to Four Inch Overlay | 184.0857 | 0 | 8.42 | 15.06 | 19.74 | 29.81 | 39.85 | 39.85 | 7.041079 | 0.819 | 17.86 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | 187.3 | 0 | 4.00 | 30.07 | 33.13 | 57.20 | 57.20 | 77.33 | 13.05476 | 0.912 | 2.86 |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 177 | 0 | 8.83 | 21.25 | 26.67 | 38.59 | 43.54 | 53.23 | 8.801471 | | |

Smoothness – Non-Polymer

Stone matrix asphalt and overlay, full depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and cold-in-place recycling and overlay did not have enough samples per year to be part of analysis. Cold planing and overlay and 2 to 4-inch overlay showed the best performance with regards to smoothness. Heater repaving and overlay showed the worst performance over time by almost twice as much per year.

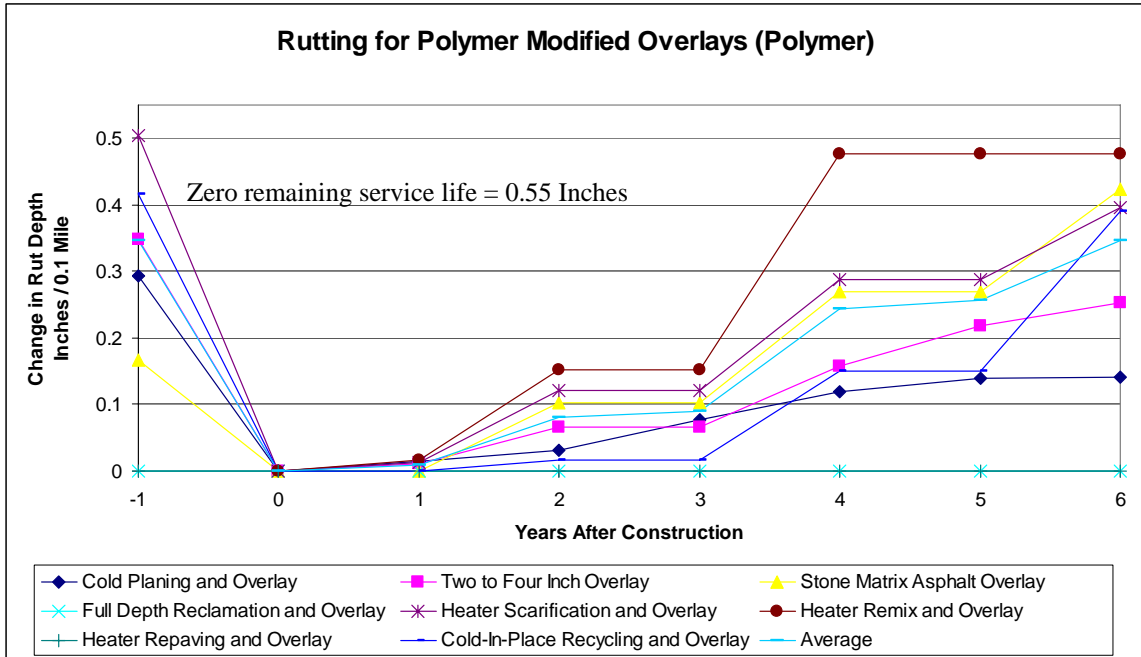


Figure 11 Permanent deformation performance after six years with relation to polymer modified pavements

Table 15 Rutting Performance – Polymer Data

| Treatment | POLYMER | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|-------|-------|-------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 0.293857 | 0.00 | 0.01 | 0.03 | 0.08 | 0.12 | 0.14 | 0.14 | 0.027146 | 0.878 | 17.71 | |
| Two to Four Inch Overlay | 0.3488 | 0 | 0.01 | 0.07 | 0.07 | 0.16 | 0.22 | 0.25 | 0.045097 | 0.844 | 17.29 | |
| Stone Matrix Asphalt Overlay | 0.1675 | 0 | - | 0.10 | 0.10 | 0.27 | 0.27 | 0.42 | 0.070607 | 0.909 | 3.57 | |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Scarification and Overlay | 0.5048 | 0 | 0.01 | 0.12 | 0.12 | 0.29 | 0.29 | 0.40 | 0.068056 | 0.85 | 8.14 | |
| Heater Remix and Overlay | --- | 0 | 0.02 | 0.15 | 0.15 | 0.48 | 0.48 | 0.48 | 0.095452 | 0.643 | 3.43 | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Cold-In-Place Recycling and Overlay | 0.4155 | 0 | - | 0.02 | 0.02 | 0.15 | 0.15 | 0.39 | 0.057375 | 0.908 | 3 | |
| Average | 0.346091 | 0 | 0.009 | 0.081 | 0.089 | 0.244 | 0.257 | 0.347 | 0.060622 | | | |

Rutting – Polymer

Stone matrix asphalt overlay, full depth reclamation and overlay, and heater repaving and overlay were not analyzed. Cold planing and overlay had considerably less amounts of rutting than the other rehabilitation strategies. Heater remix and overlay had the most amount of rutting per year.

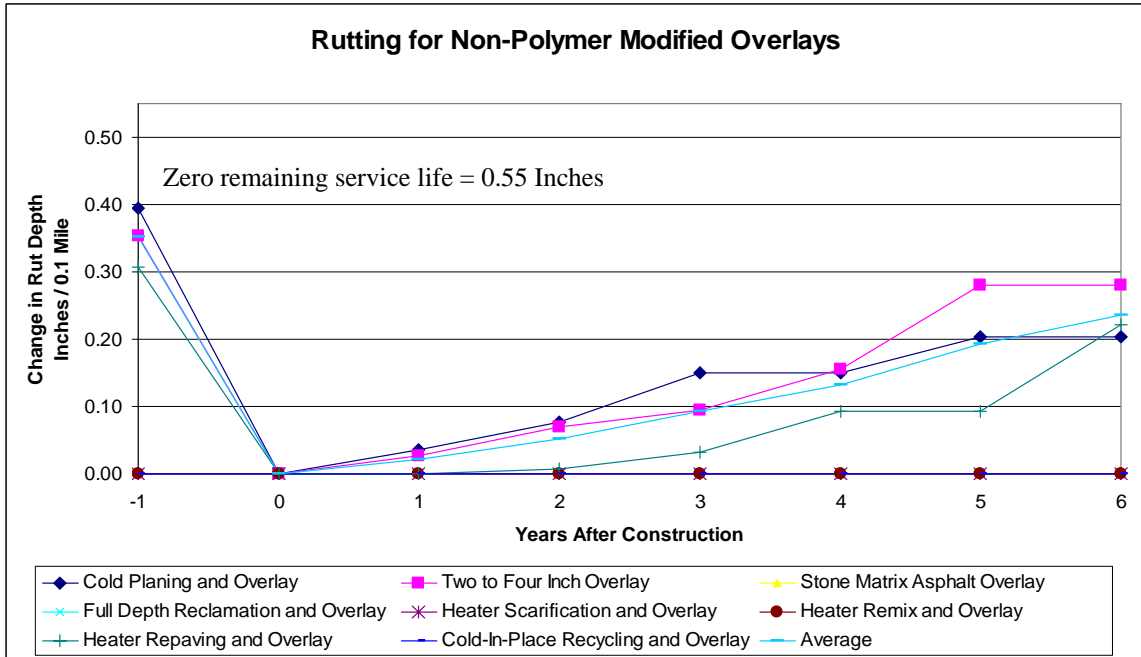


Figure 12 Permanent deformation performance after six years with relation to non-polymer modified pavements

Table 16 Rutting Performance – Non-Polymer Data

| Treatment | NON-POLYMER | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-------------|------|------|------|------|------|------|------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | 0.394923 | 0 | 0.04 | 0.08 | 0.15 | 0.15 | 0.20 | 0.20 | 0.036407 | 0.904 | 11.71 | | |
| Two to Four Inch Overlay | 0.352759 | 0 | 0.03 | 0.07 | 0.10 | 0.15 | 0.28 | 0.28 | 0.051271 | 0.636 | 27.29 | | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Repaving and Overlay | 0.307 | 0 | - | 0.01 | 0.03 | 0.09 | 0.09 | 0.22 | 0.033429 | 0.936 | 2.86 | | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Average | 0 | 0 | 0.02 | 0.05 | 0.09 | 0.13 | 0.19 | 0.24 | 0.040369 | | | | |

Rutting – Non-Polymer

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Both cold planing and overlay and heater repaving and overlay performed similarly and had less amounts of rutting per year than the other rehabilitation strategies. Two to 4-inch overlay had the most amount of rutting per year.

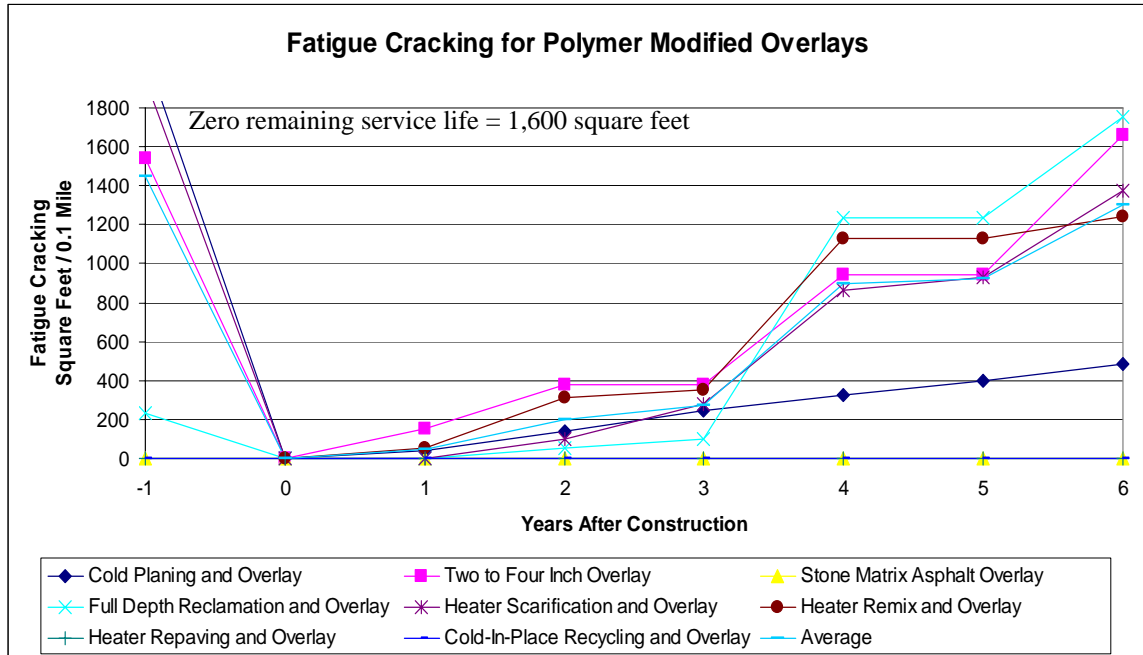


Figure 13 Fatigue cracking performance after six years with relation to polymer modified pavements

Table 17 Fatigue Performance – Polymer Data

| Treatment | POLYMER | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|----------|----------|----------|----------|-----------|-----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 2077.318 | 0.00 | 41.44 | 138.32 | 242.82 | 328.40 | 397.56 | 483.34 | 84.01194 | 0.436 | 17.29 |
| Two to Four Inch Overlay | 1541.089 | 0 | 155.23 | 380.73 | 380.73 | 944.47 | 944.47 | 1,662.64 | 254.6479 | 0.446 | 15.57 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | 234.8 | 0 | - | 54.50 | 100.00 | 1,232.20 | 1,232.20 | 1,752.80 | 317.875 | 0.273 | 3 |
| Heater Scarification and Overlay | 1944.314 | 0 | - | 100.88 | 275.93 | 866.23 | 928.59 | 1,376.45 | 241.139 | 0.643 | 8.29 |
| Heater Remix and Overlay | ---- | 0 | 50.90 | 312.35 | 351.70 | 1,126.15 | 1,126.15 | 1,242.25 | 238.9661 | 0.643 | 3.43 |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 1449.38 | 0 | 49.51485 | 197.3564 | 270.2376 | 899.491 | 925.79391 | 1303.4969 | 227.328 | | |

Fatigue – Polymer

Stone matrix asphalt overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay had considerably less fatigue cracking than the other rehabilitation strategies. The coefficient of determination shows that the data is not represented very well with regards to all rehabilitation strategies as shown in Table 17.

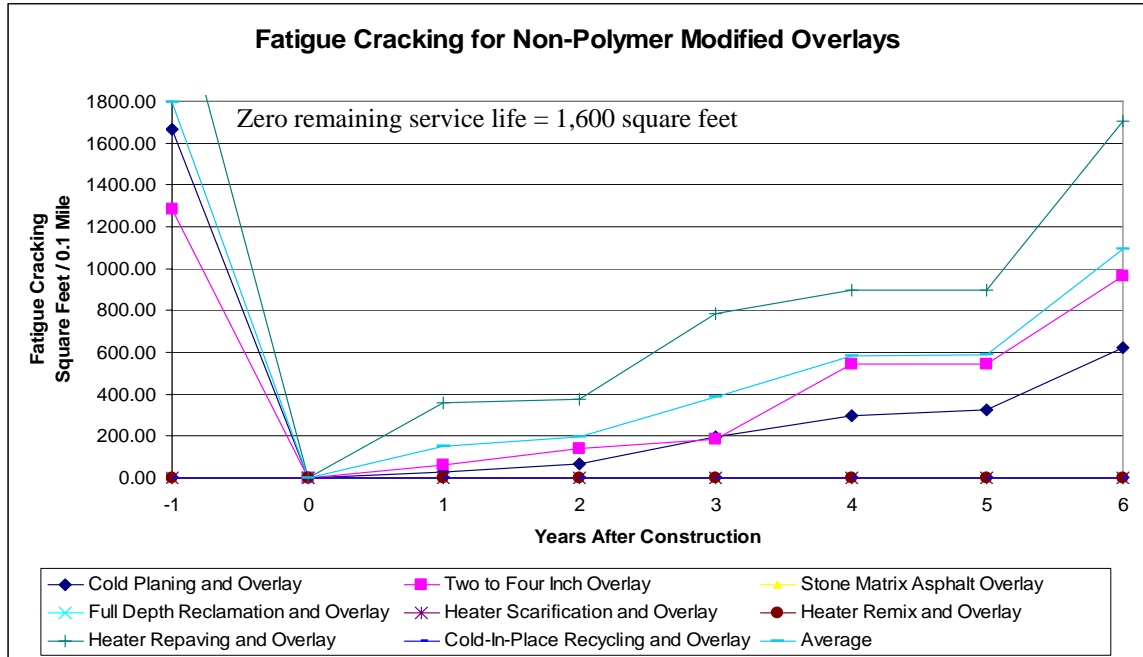


Figure 14 Fatigue cracking performance after six years with relation to non-polymer modified pavements

Table 18 Fatigue Performance – Non-Polymer Data

| Treatment | NON-POLYMER | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-------------|-----|--------|--------|--------|--------|--------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 1667.67 | 0 | 28.93 | 68.41 | 197.31 | 299.74 | 325.88 | 620.82 | 95.98946 | 0.653 | 11.29 |
| Two to Four Inch Overlay | 1282.169 | 0 | 61.05 | 138.75 | 183.73 | 544.34 | 544.34 | 962.00 | 152.0779 | 0.424 | 28.17 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | 2429.1 | 0 | 361.45 | 377.60 | 783.00 | 899.35 | 899.35 | 1,702.05 | 239.4179 | 0.697 | 3.71 |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 1793 | 0 | 150.48 | 194.92 | 388.02 | 581.14 | 589.86 | 1094.96 | 162.4951 | | |

Fatigue – Non-Polymer

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less amount of fatigue cracking per year than the other two rehabilitation strategies represented. Heater repaving and overlay showed the most amount of fatigue cracking per year as shown in Table 18.

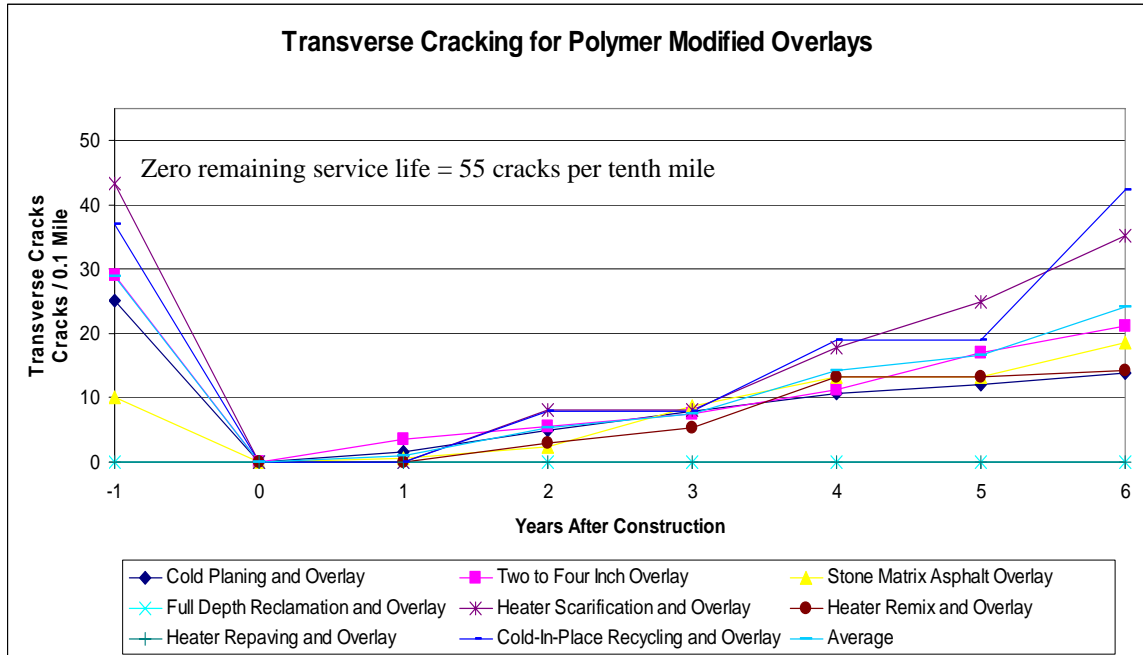


Figure 15 Transverse cracking performance after six years with relation to polymer modified pavements

Table 19 Transverse Cracking Performance – Polymer Data

| Treatment | POLYMER | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|----------|----------|----------|----------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 25.104 | 0 | 1.60 | 5.00 | 7.93 | 10.73 | 12.01 | 13.82 | 2.42921 | 0.702 | 25.57 |
| Two to Four Inch Overlay | 29.16 | 0 | 3.50 | 5.50 | 7.54 | 11.30 | 16.99 | 21.17 | 3.439269 | 0.674 | 19.43 |
| Stone Matrix Asphalt Overlay | 10.05 | 0 | 0.67 | 2.37 | 8.68 | 13.24 | 13.24 | 18.51 | 3.269286 | 0.601 | 4.43 |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 43.425 | 0 | - | 8.07 | 8.07 | 17.89 | 24.99 | 35.17 | 5.904275 | 0.761 | 10.57 |
| Heater Remix and Overlay | ---- | 0 | - | 2.88 | 5.40 | 13.32 | 13.32 | 14.22 | 2.847857 | 0.859 | 4.14 |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | 36.93333 | 0 | - | 7.93 | 7.93 | 18.93 | 18.93 | 42.33 | 6.280357 | 0.595 | 4.43 |
| Average | 28.93447 | 0 | 0.959596 | 5.289845 | 7.591555 | 14.23481 | 16.57962 | 24.20317 | 4.028376 | | |

Transverse Cracking – Polymer

Full-depth reclamation and overlay and heater repaving and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Cold-in-place recycling and overlay had the most transverse cracking per year as shown in Table 19.

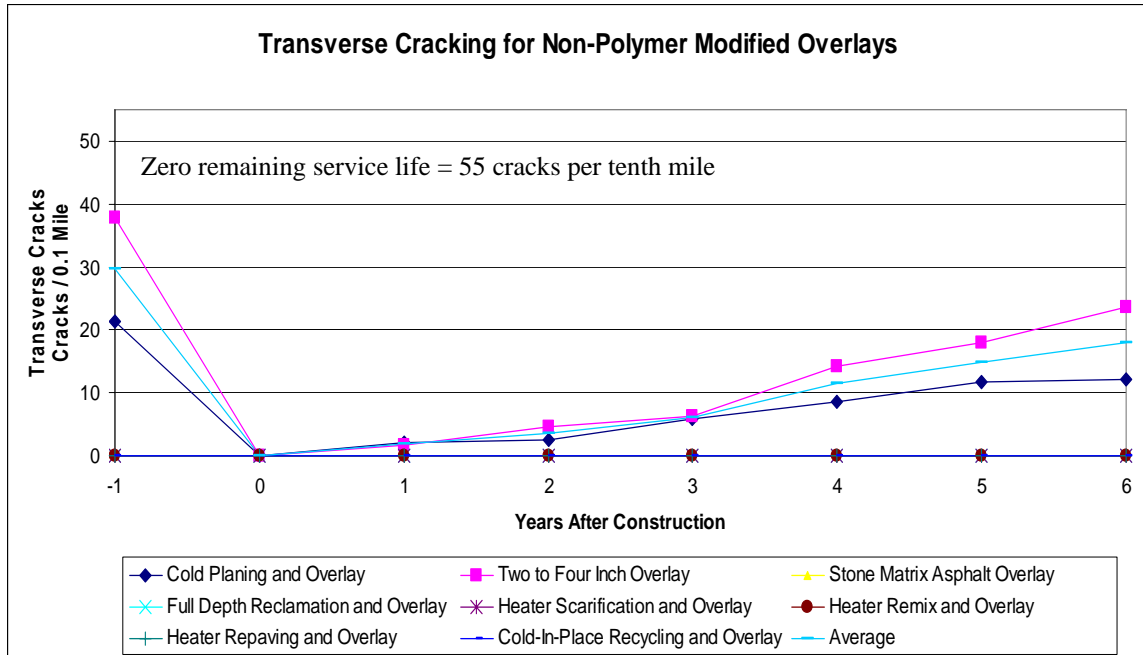


Figure 16 Transverse cracking performance after six years with relation to non-polymer modified pavements

Table 20 Transverse Cracking Performance – Non-Polymer Data

| Treatment | NON-POLYMER | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-------------|-----|------|------|------|-------|-------|-------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 21.3875 | 0 | 2.09 | 2.53 | 5.84 | 8.61 | 11.61 | 12.17 | 2.20057 | 0.743 | 14.57 |
| Two to Four Inch Overlay | 37.93333 | 0 | 1.63 | 4.54 | 6.19 | 14.21 | 18.05 | 23.72 | 4.060033 | 0.7 | 37.86 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 30 | 0 | 1.86 | 3.53 | 6.02 | 11.41 | 14.83 | 17.94 | 3.130301 | | |

Transverse Cracking – Non-Polymer

Stone matrix asphalt and overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed half as much transverse cracking per year than 2 to 4-inch overlay as shown in Table 20.

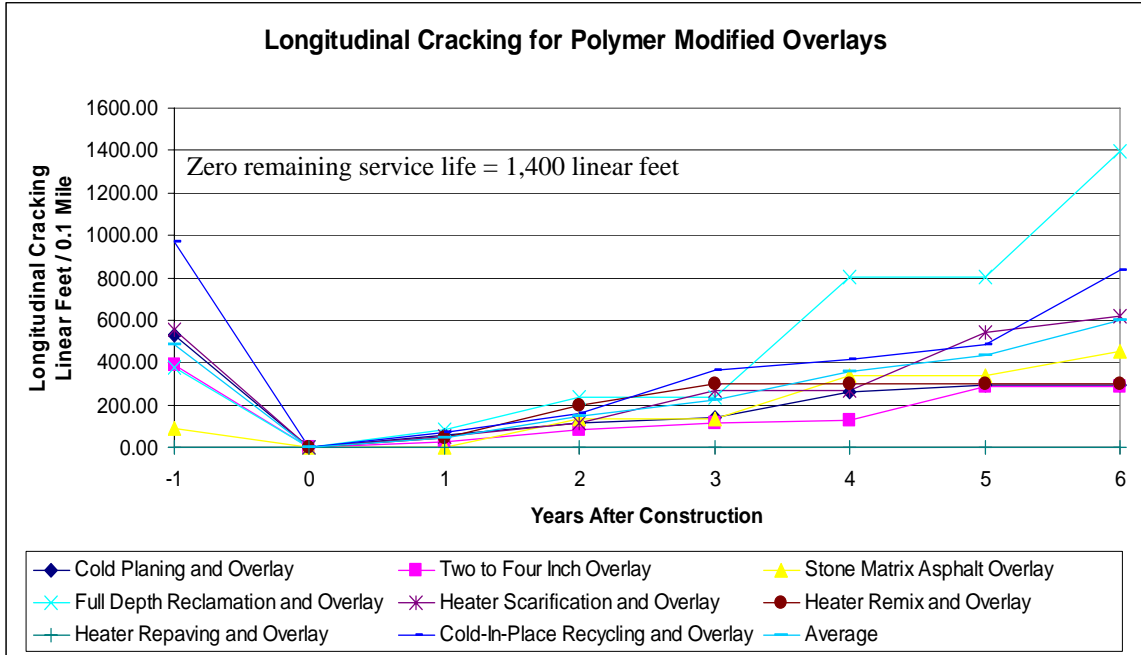


Figure 17 Longitudinal cracking performance after six years with relation to polymer modified pavements

Table 21 Longitudinal Cracking Performance – Polymer Data

| Treatment | POLYMER | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|----------|-----------|-----------|-----------|-----------|-----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 528.94 | 0 | 55.13 | 112.42 | 140.58 | 258.40 | 292.81 | 292.81 | 53.56283 | 0.642 | 15 |
| Two to Four Inch Overlay | 387.7429 | 0 | 23.86 | 80.24 | 117.91 | 129.18 | 287.89 | 287.89 | 51.45222 | 0.508 | 9.86 |
| Stone Matrix Asphalt Overlay | 92.2 | 0 | 2.40 | 131.45 | 131.45 | 334.92 | 334.92 | 454.52 | 79.71607 | 0.571 | 2.71 |
| Full Depth Reclamation and Overlay | 378.8 | 0 | 80.02 | 236.37 | 236.37 | 804.45 | 804.45 | 1,396.55 | 221.6643 | 0.674 | 3 |
| Heater Scarification and Overlay | 556.15 | 0 | 50.76 | 116.65 | 265.43 | 268.05 | 542.72 | 615.50 | 106.494 | 0.698 | 9.57 |
| Heater Remix and Overlay | --- | 0 | 44.64 | 197.44 | 297.24 | 297.24 | 297.24 | 297.24 | 53.45429 | 0.753 | 4 |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | 969.5333 | 0 | 70.46 | 160.44 | 360.56 | 414.48 | 483.36 | 836.11 | 128.1489 | 0.659 | 4.43 |
| Average | 485.5606 | 0 | 46.75267 | 147.85716 | 221.36306 | 358.10185 | 434.76967 | 597.23056 | 99.21323 | | |

Longitudinal Cracking – Polymer

Heater repaving and overlay is the only rehabilitation strategy not represented. Cold planing and overlay, 2 to 4 inch overlay, and heater remix and overlay all showed similar amounts of longitudinal cracking per year and performed better than the other rehabilitation strategies. Full depth reclamation and overlay showed significantly more longitudinal cracking per year than the other rehabilitation strategies as shown in Table 21.

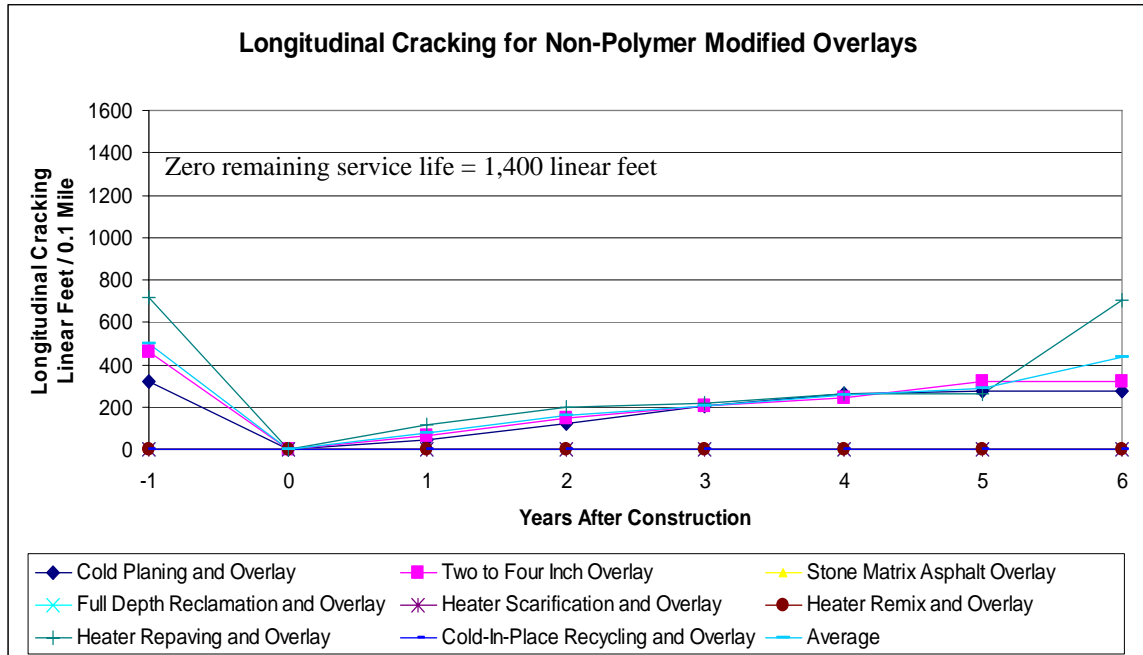


Figure 18 Longitudinal cracking performance after six years with relation to non-polymer modified pavements

Table 22 Longitudinal Cracking Performance – Non-Polymer Data

| Treatment | NON-POLYMER | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-------------|-----|--------|--------|--------|--------|--------|--------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 322.2429 | 0 | 43.51 | 123.44 | 204.61 | 263.79 | 272.57 | 272.57 | 50.57859 | 0.695 | 12.57 |
| Two to Four Inch Overlay | 460.6933 | 0 | 63.02 | 148.22 | 204.03 | 243.83 | 321.05 | 321.05 | 56.24277 | 0.652 | 26.86 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | 716.4 | 0 | 115.10 | 199.05 | 214.50 | 261.65 | 261.65 | 705.45 | 88.2875 | 0.808 | 3.14 |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 500 | 0 | 73.88 | 156.90 | 207.71 | 256.42 | 285.09 | 433.02 | 65.03629 | | |

Longitudinal Cracking – Non-Polymer

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of longitudinal cracking per year. Heater repaving and overlay showed the most amount of longitudinal cracking per year as shown in Table 22.

CUMULATIVE INCREASE IN DISTRESSES OVER TIME IN RELATION TO TRAFFIC COUNTS

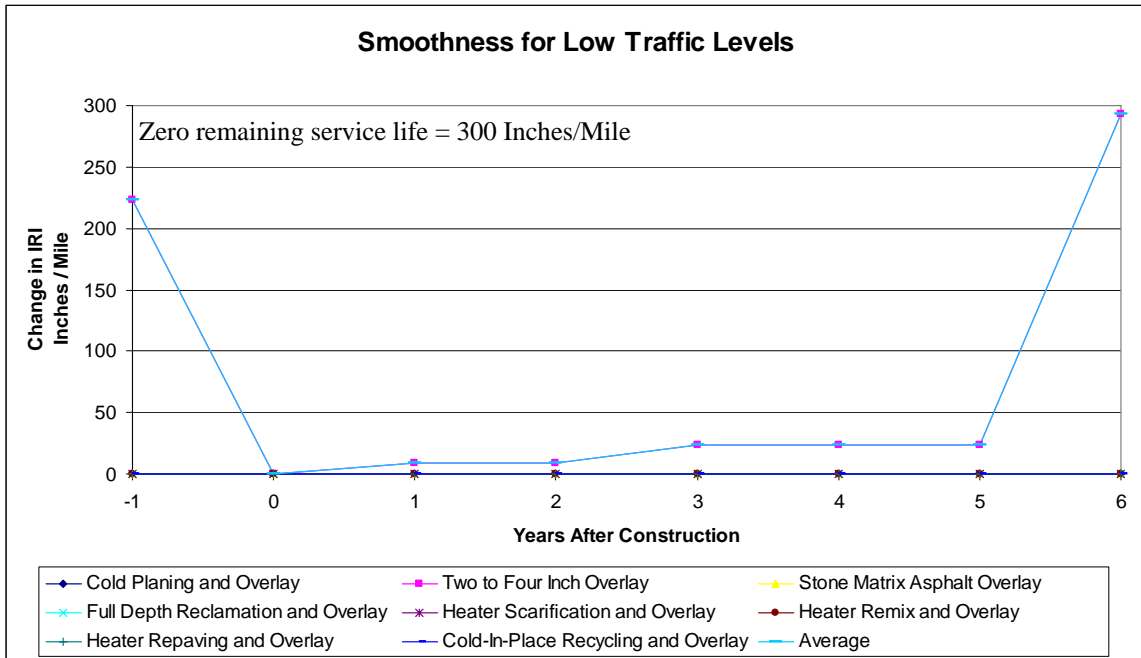


Figure 19 Rate of change for smoothness after six years with relation to traffic counts of less than 0.3 million ESAL

Table 23 Smoothness Performance – Low Traffic Data

| Treatment | Low | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|------------|----------|-------------|-------------|--------------|--------------|--------------|----------------|-----------------|
| | -1 | 0 | 1 | 2 | 3 | 4 | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 223.5333 | 0 | 8.76 | 8.76 | 23.13 | 23.13 | 23.13 | 293.53 | 32.98857 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 224 | 0 | 8.76 | 8.76 | 23.13 | 23.13 | 23.13 | 293.53 | 32.98857 |

Smoothness – Low Traffic

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done on other strategies.

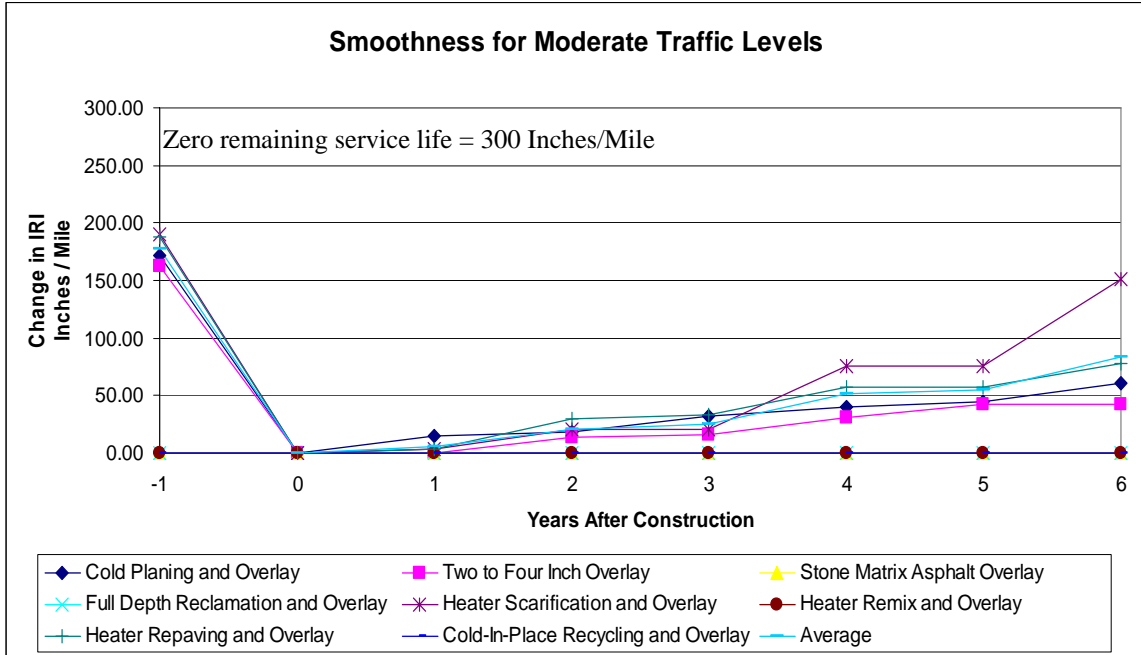


Figure 20 Rate of change for smoothness after six years with relation to traffic counts from 0.3 to 3 million ESAL

Table 24 Smoothness Performance – Moderate Traffic Data

| Treatment | Moderate | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|-------|-------|-------|-------|-------|--------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 171.80 | 0 | 14.74 | 18.70 | 32.53 | 40.01 | 45.14 | 60.87 | 9.453912 | 0.824 | 12.86 |
| Two to Four Inch Overlay | 163.0909 | 0 | - | 13.22 | 15.80 | 31.31 | 42.67 | 42.67 | 8.26588 | 0.828 | 17.57 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | 189.9333 | 0 | 3.44 | 20.05 | 20.05 | 75.87 | 75.87 | 151.27 | 23.37585 | 0.819 | 6.29 |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | 187.3 | 0 | 4.00 | 30.07 | 33.13 | 57.20 | 57.20 | 77.33 | 13.05476 | 0.912 | 2.86 |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 178 | 0 | 5.54 | 20.51 | 25.38 | 51.10 | 55.22 | 83.04 | 13.5376 | | |

Smoothness – Moderate Traffic

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed the best performance for smoothness over time. Heater scarification and overlay showed significantly worse performance than the other rehabilitation strategies as shown in Table 24.

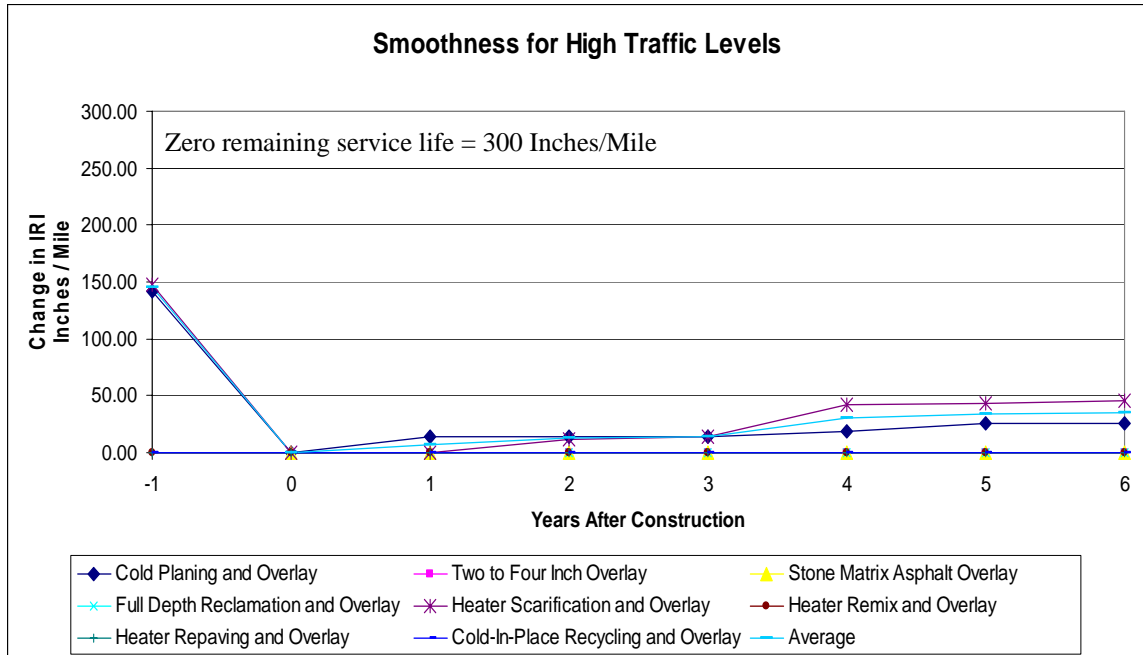


Figure 21 Rate of change for smoothness after six years with relation to traffic counts from 3 to 11 million ESAL

Table 25 Smoothness Performance – High Traffic Data

| Treatment | High | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|--------|-----|-------|-------|-------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 141.98 | 0 | 14.30 | 14.30 | 14.30 | 18.63 | 25.57 | 25.57 | 3.69881 | 0.829 | 3.43 | |
| Two to Four Inch Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Scarification and Overlay | 147.8 | 0 | - | 12.16 | 14.36 | 42.72 | 43.47 | 45.60 | 9.081905 | 0.899 | 4.14 | |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Average | 145 | 0 | 7.15 | 13.23 | 14.33 | 30.68 | 34.52 | 35.58 | 6.390357 | | | |

Smoothness – High Traffic

Two to 4-inch overlay, stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly better performance than heater scarification and overlay as shown in Table 25.

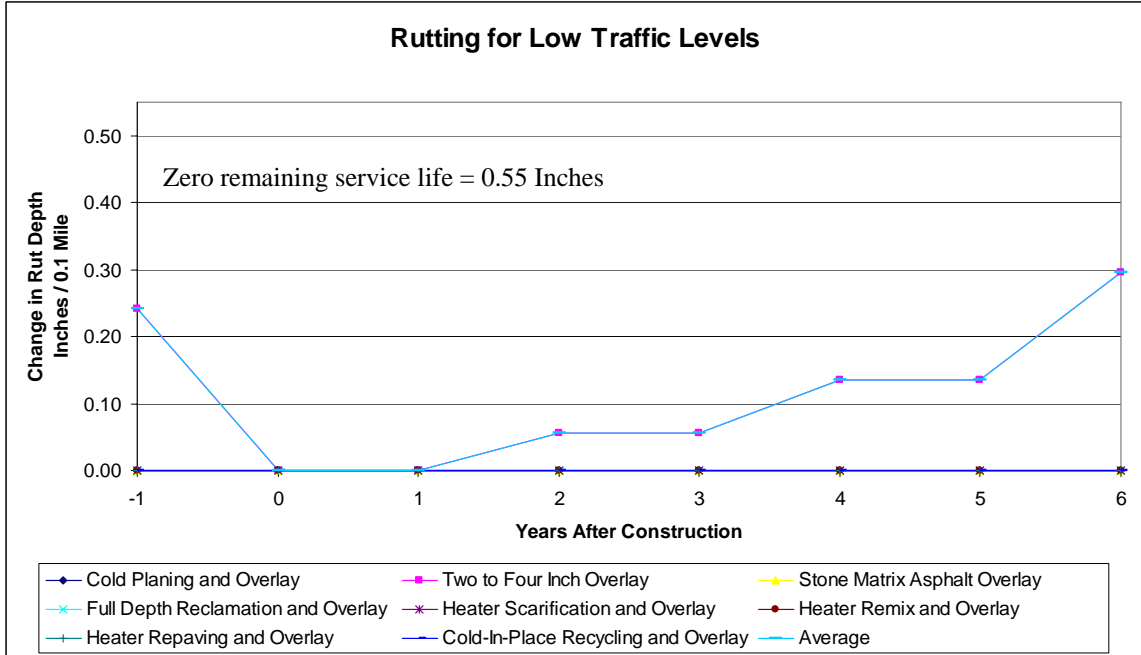


Figure 22 Permanent deformation performance after six years with relation to traffic counts of less than 0.3 million ESAL

Table 26 Rutting Performance – Low Traffic Data

| Treatment | Low | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 0.241333 | 0 | - | 0.06 | 0.06 | 0.14 | 0.14 | 0.30 | 0.044147 | 0.782 | 7.86 | ---- | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 0 | 0 | 0.00 | 0.06 | 0.06 | 0.14 | 0.14 | 0.30 | 0.044147 | ---- | ---- | ---- | |

Rutting – Low Traffic

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

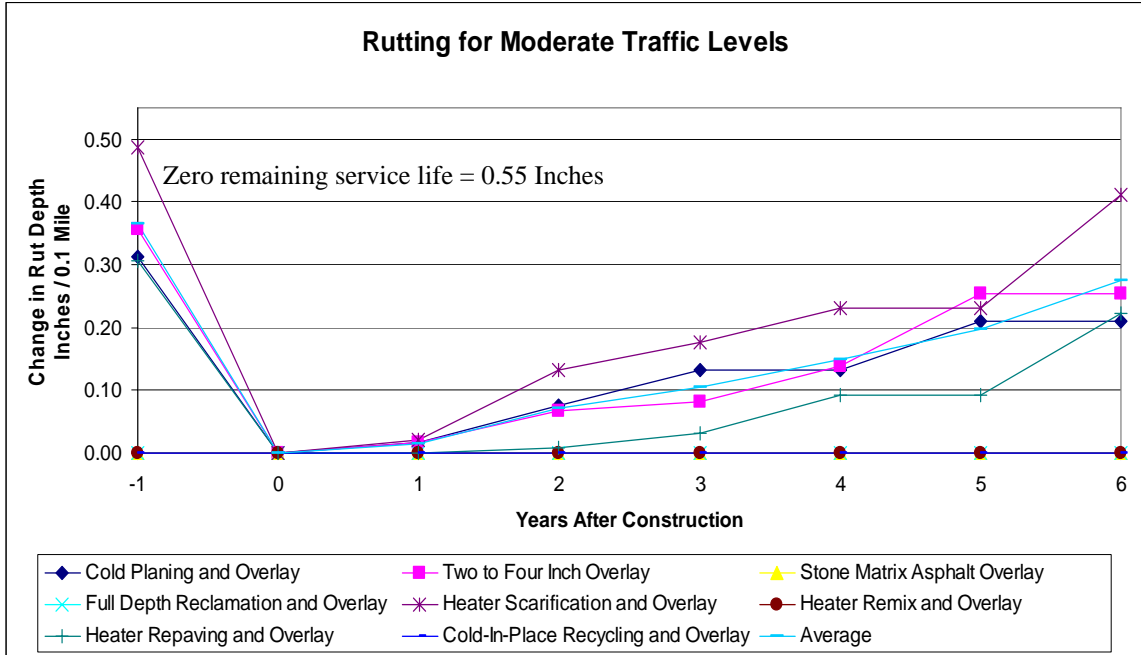


Figure 23 Permanent deformation performance after six years with relation to traffic counts from 0.3 to 3 million ESAL

Table 27 Rutting Performance – Moderate Traffic Data

| Treatment | Moderate | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | 0.312308 | 0 | 0.02 | 0.08 | 0.13 | 0.13 | 0.21 | 0.21 | 0.038381 | 0.901 | 14.43 | | |
| Two to Four Inch Overlay | 0.357652 | 0 | 0.02 | 0.07 | 0.08 | 0.14 | 0.25 | 0.25 | 0.046804 | 0.615 | 27.14 | | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Scarification and Overlay | 0.48725 | 0 | 0.02 | 0.13 | 0.18 | 0.23 | 0.23 | 0.41 | 0.062598 | 0.774 | 8.57 | | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Repaving and Overlay | 0.307 | 0 | - | 0.01 | 0.03 | 0.09 | 0.09 | 0.22 | 0.033429 | 0.936 | 2.86 | | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Average | 0 | 0 | 0.01 | 0.07 | 0.11 | 0.15 | 0.20 | 0.27 | 0.045303 | | | | |

Rutting – Moderate Traffic

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Both cold planing and overlay and heater repaving and overlay showed the least amount of rutting per year than the other rehabilitation strategies. Heater scarification and overlay showed the most amount of rutting per year as shown in Table 27.



Figure 24 Permanent deformation performance after six years with relation to traffic counts from 3 to 11 million ESAL

Table 28 Rutting Performance – High Traffic Data

| Treatment | High | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 0.399077 | 0 | 0.04 | 0.04 | 0.09 | 0.15 | 0.15 | 0.18 | 0.031613 | 0.857 | 13 | |
| Two to Four Inch Overlay | 0.474286 | 0 | 0.06 | 0.10 | 0.12 | 0.24 | 0.30 | 0.34 | 0.05914 | 0.908 | 9.57 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 0 | 0 | 0.05 | 0.07 | 0.10 | 0.20 | 0.23 | 0.26 | 0.045377 | | | |

Rutting – High Traffic

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed less amounts of rutting per year than 2 to 4 inch overlay as shown in Table 28.

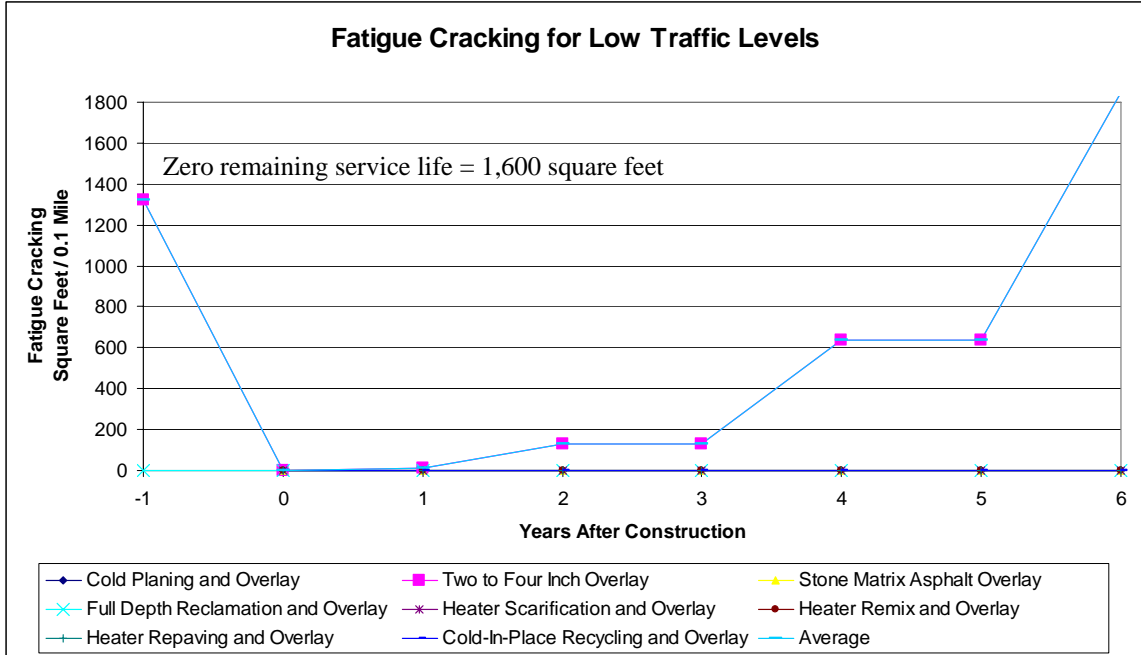


Figure 25 Fatigue cracking performance after six years with relation to traffic counts of less than 0.3 million ESAL

Table 29 Fatigue Performance – Low Traffic Data

| Treatment | Low | | | | | | | Slope | R ² | n, Avg | |
|-------------------------------------|---------|-----|-------|--------|--------|--------|--------|----------|----------------|--------|-----|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Two to Four Inch Overlay | 1320.96 | 0 | 14.42 | 131.24 | 131.24 | 638.51 | 638.51 | 1,845.87 | 260.4668 | 0.282 | 10 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 1321 | 0 | 14.42 | 131.24 | 131.24 | 638.51 | 638.51 | 1845.87 | 260.4668 | | |

Fatigue – Low Traffic

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

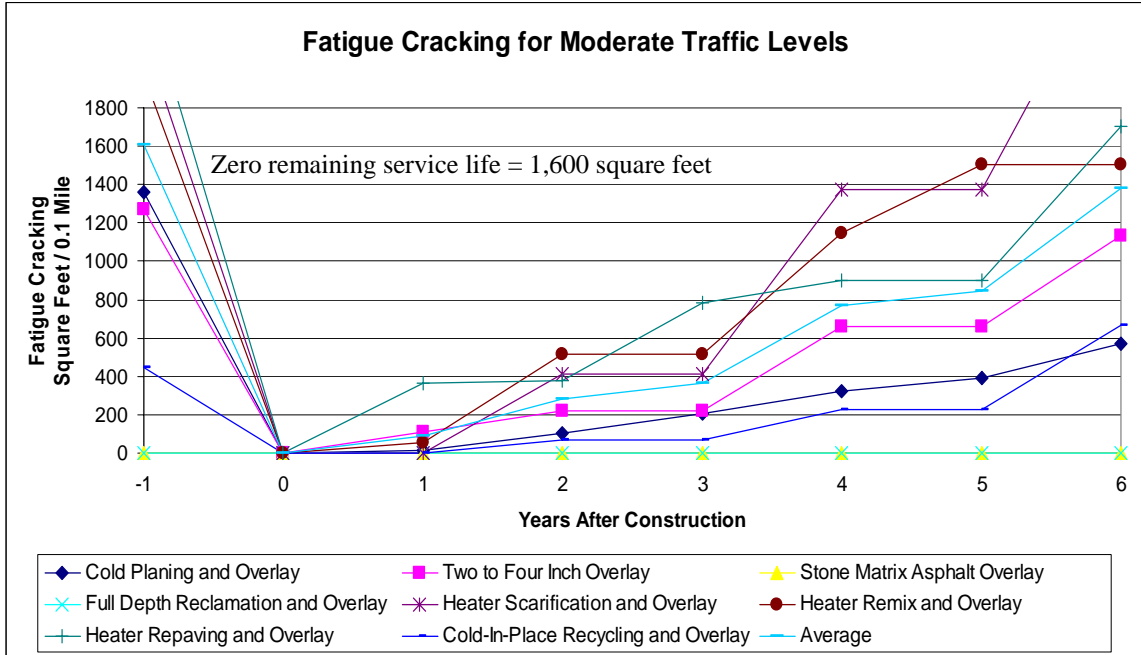


Figure 26 Fatigue cracking performance after six years with relation to traffic counts from 0.3 to 3 million ESAL

Table 30 Traffic Fatigue Performance – Moderate Traffic Data

| Treatment | Moderate | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|--------|--------|--------|----------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 1363.65 | 0 | 17.11 | 100.37 | 203.12 | 321.00 | 392.37 | 567.01 | 95.43421 | 0.458 | 20.14 |
| Two to Four Inch Overlay | 1267.979 | 0 | 112.04 | 218.36 | 218.36 | 656.11 | 656.11 | 1,136.94 | 176.312 | 0.417 | 30.43 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 2168.343 | 0 | 2.15 | 408.93 | 408.93 | 1,376.90 | 1,376.90 | 2,715.12 | 423.6718 | 0.608 | 5.43 |
| Heater Remix and Overlay | 1971.15 | 0 | 56.69 | 513.60 | 513.60 | 1,145.83 | 1,503.60 | 1,503.60 | 287.0303 | 0.539 | 4.71 |
| Heater Repaving and Overlay | 2429.1 | 0 | 361.45 | 377.60 | 783.00 | 899.35 | 899.35 | 1,702.05 | 239.4179 | 0.697 | 3.71 |
| Cold-In-Place Recycling and Overlay | 444.2 | 0 | - | 71.07 | 71.07 | 223.47 | 223.47 | 667.67 | 92.94048 | 0.765 | 0.86 |
| Average | 1607 | 0 | 91.57 | 281.66 | 366.35 | 770.44 | 841.97 | 1382.06 | 219.1344 | | |

Fatigue – Moderate Traffic

Stone matrix asphalt overlay, full-depth reclamation and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less amount of fatigue cracking per year than the other rehabilitation strategies. Heater scarification and overlay showed significantly more amounts of fatigue cracking than the other rehabilitation strategies. The coefficient of determination shows that the data is not represented very well overall as shown in Table 30.

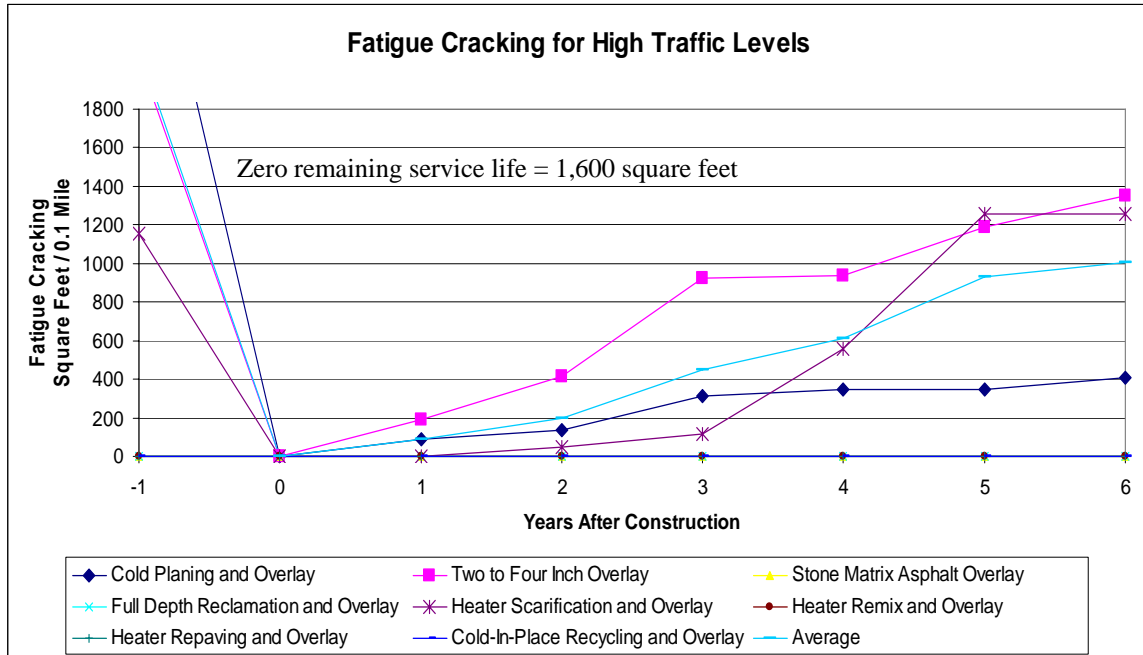


Figure 27 Fatigue cracking performance after six years with relation to traffic counts from 3 to 11 million ESAL

Table 31 Traffic Fatigue Performance – High Traffic Data

| Treatment | High | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|--------|--------|--------|--------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 3113.933 | 0 | 86.28 | 138.48 | 309.34 | 343.80 | 343.80 | 407.73 | 69.41194 | 0.672 | 7.71 |
| Two to Four Inch Overlay | 2062.067 | 0 | 187.97 | 411.12 | 926.62 | 940.12 | 1,187.67 | 1,348.67 | 234.8 | 0.873 | 3.29 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 1155.3 | 0 | - | 46.12 | 113.04 | 555.24 | 1,253.55 | 1,253.55 | 242.0305 | 0.759 | 4.14 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 2110 | 0 | 91.42 | 198.57 | 449.67 | 613.05 | 928.34 | 1003.31 | 182.0808 | | |

Fatigue – High Traffic

Stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed a significant less amount of fatigue cracking than the other rehabilitation strategies. Both 2 to 4 inch overlay and heater scarification and overlay showed similar amounts of fatigue cracking per year and performed the worst as shown in Table 31.

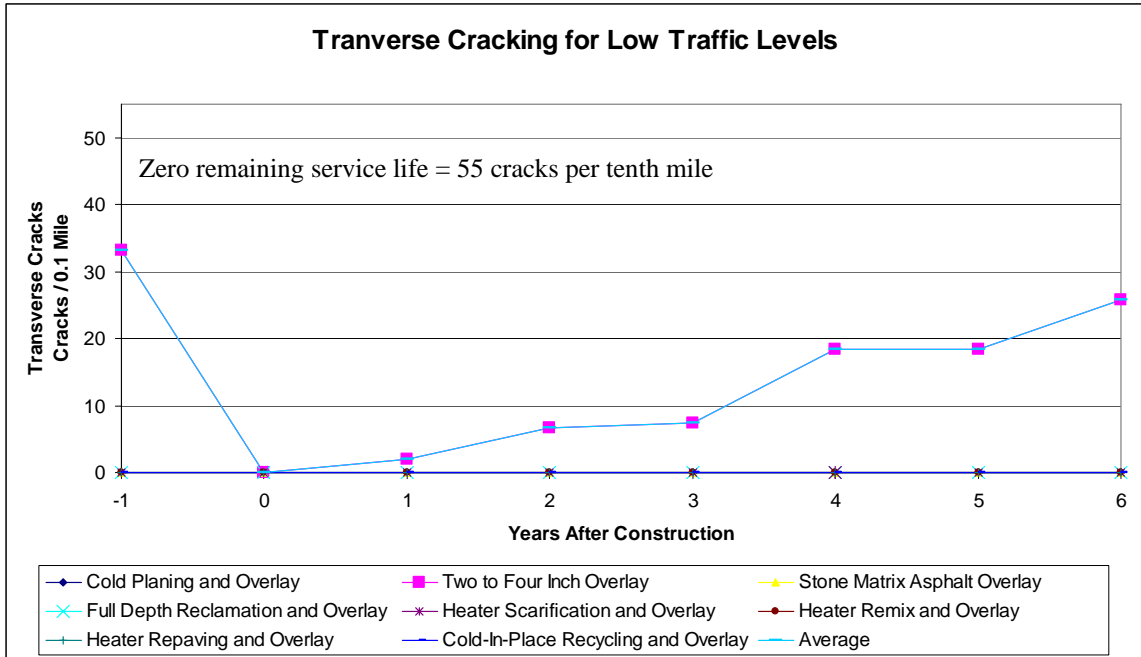


Figure 28 Transverse cracking performance after six years with relation to traffic counts of less than 0.3 million ESAL

Table 32 Transverse Cracking Performance – Low Traffic Data

| Treatment | Low | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|------|------|------|-------|-------|-------|---------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Two to Four Inch Overlay | 33.21818 | 0 | 1.91 | 6.73 | 7.48 | 18.42 | 18.42 | 25.78 | 4.35875 | 0.715 | 13.29 | --- | |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Average | 33 | 0 | 1.91 | 6.73 | 7.48 | 18.42 | 18.42 | 25.78 | 4.35875 | --- | --- | --- | |

Transverse Cracking – Low Traffic

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

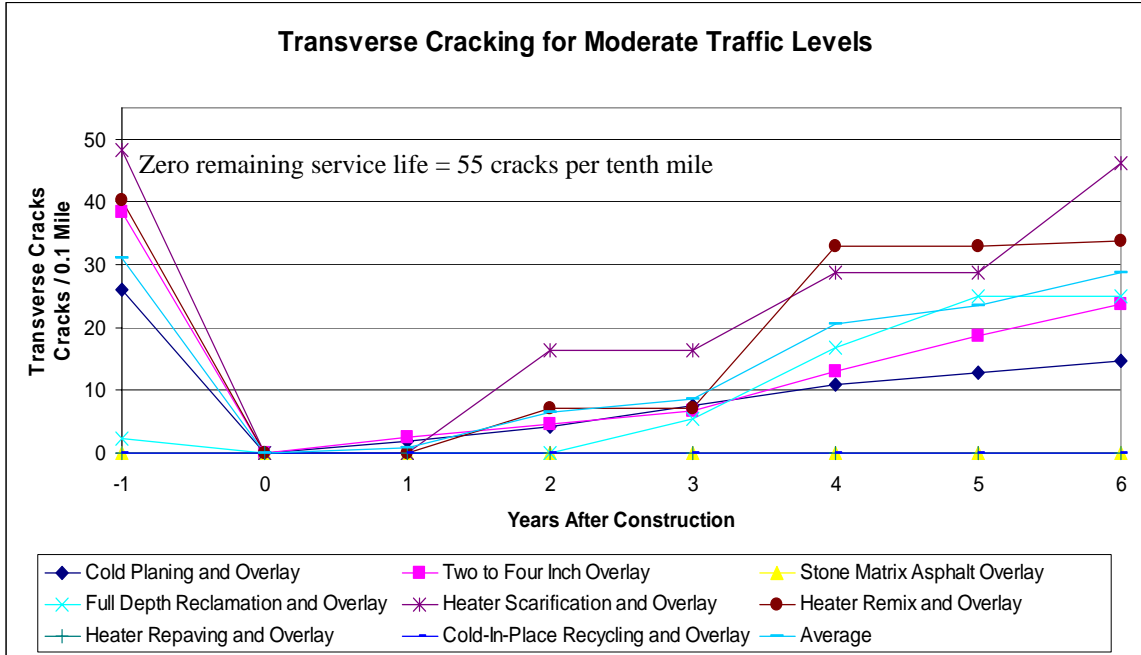


Figure 29 Transverse cracking performance after six years with relation to traffic counts from 0.3 to 3 million ESAL

Table 33 Traffic Transverse Cracking Performance – Moderate Traffic Data

| Treatment | Moderate | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|-------|-------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 26.1037 | 0 | 1.85 | 4.11 | 7.61 | 10.89 | 12.73 | 14.68 | 2.591981 | 0.744 | 27.43 | |
| Two to Four Inch Overlay | 38.46429 | 0 | 2.55 | 4.58 | 6.62 | 13.07 | 18.68 | 23.74 | 3.99878 | 0.684 | 34.71 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | 2.4 | 0 | - | - | 5.56 | 16.86 | 24.96 | 24.96 | 5.059286 | 0.711 | 3.86 | |
| Heater Scarification and Overlay | 48.23333 | 0 | - | 16.29 | 16.29 | 28.76 | 28.76 | 46.16 | 7.444841 | 0.696 | 6.71 | |
| Heater Remix and Overlay | 40.35 | 0 | - | 7.11 | 7.11 | 32.87 | 32.87 | 33.77 | 6.886701 | 0.566 | 4.71 | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 31 | 0 | 0.88 | 6.42 | 8.64 | 20.49 | 23.60 | 28.66 | 5.196318 | | | |

Transverse Cracking – Moderate Traffic

Stone matrix asphalt overlay, heater remix and overlay, and heater repaving and overlay are not represented. Cold planing and overlay had the least amount of transverse cracking per year than the other rehabilitation strategies. Heater scarification and overlay had the most amount of transverse cracking per year as shown in Table 33.

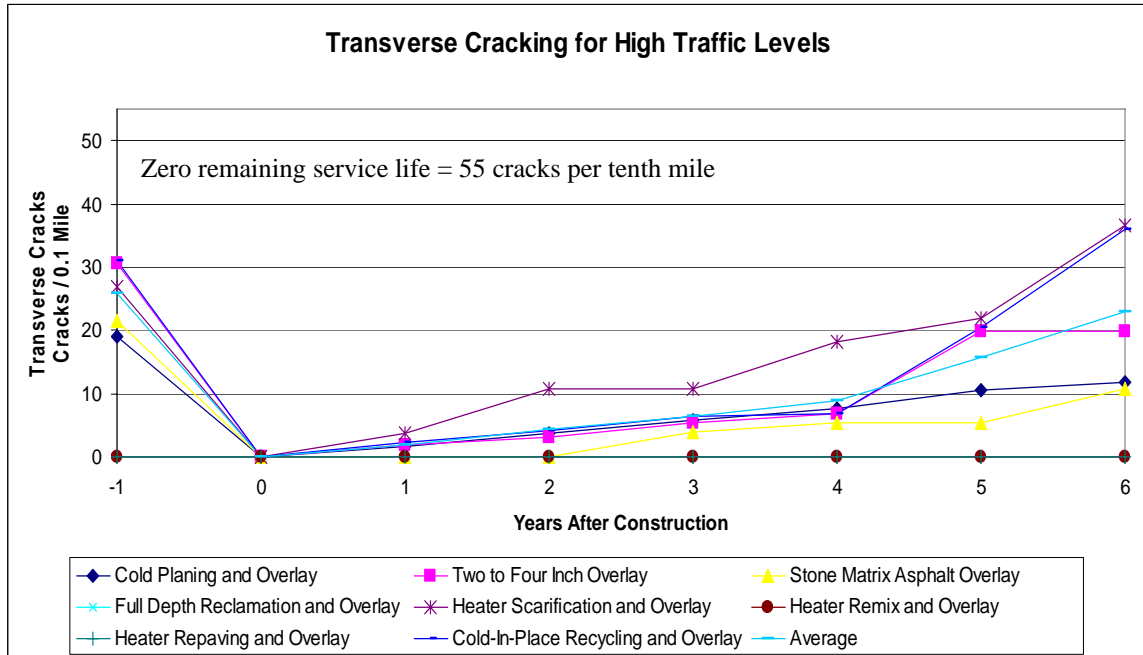


Figure 30 Transverse cracking performance after six years with relation to traffic counts from 3 to 11 million ESAL

Table 34 Transverse Cracking Performance – High Traffic Data

| Treatment | High | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|-------|-------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 18.92857 | 0 | 1.56 | 3.74 | 5.82 | 7.74 | 10.59 | 11.82 | 2.053537 | 0.711 | 12.71 | |
| Two to Four Inch Overlay | 30.68571 | 0 | 1.79 | 3.19 | 5.42 | 6.81 | 19.82 | 19.82 | 3.540631 | 0.708 | 9.29 | |
| Stone Matrix Asphalt Overlay | 21.6 | 0 | - | - | 4.00 | 5.47 | 5.47 | 10.73 | 1.735714 | 0.806 | 2.71 | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 26.8 | 0 | 3.73 | 10.77 | 10.77 | 18.10 | 21.82 | 36.52 | 5.466071 | 0.894 | 5.14 | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | 31 | 0 | 2.20 | 4.20 | 6.33 | 6.80 | 20.53 | 36.07 | 5.266667 | 0.629 | 3 | |
| Average | 26 | 0 | 1.86 | 4.38 | 6.47 | 8.98 | 15.64 | 22.99 | 3.612524 | | | |

Transverse Cracking – High Traffic

Full-depth reclamation and overlay, heater remix and overlay, and heater repaving and overlay are not represented. Stone matrix asphalt overlay had the least amount of transverse cracking per year with cold planing and overlay having a similar amount of cracking. Both heater scarification and overlay and cold-in-place recycling and overlay had the most amounts of transverse cracking per year as shown in Table 34.

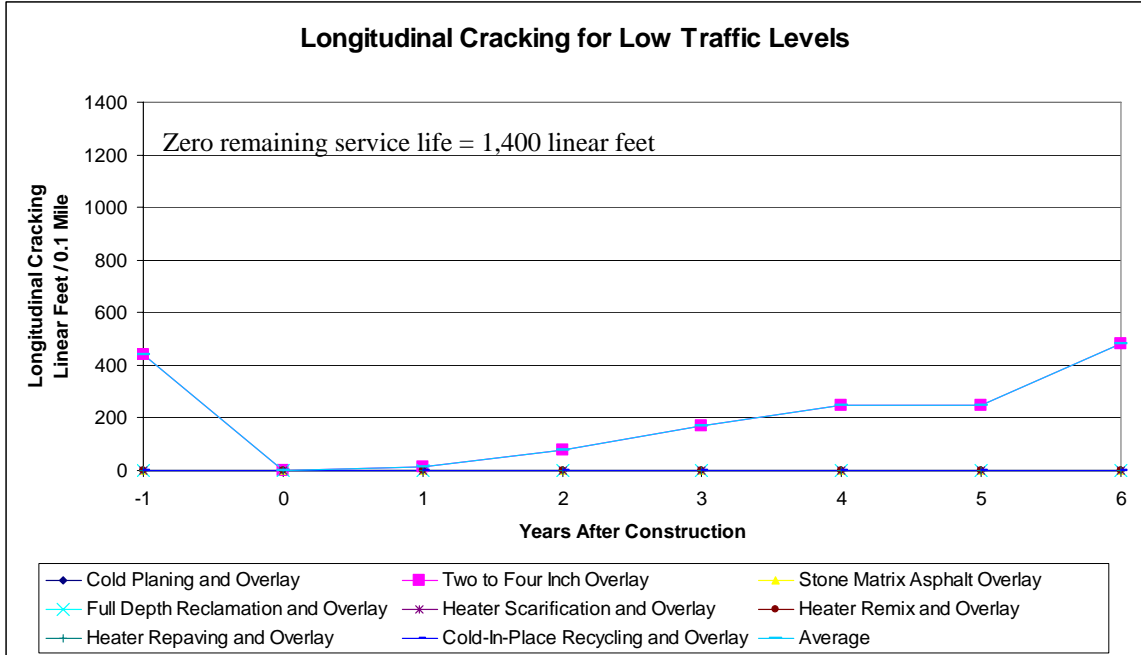


Figure 31 Longitudinal cracking performance after six years with relation to traffic counts of less than 0.3 million ESAL

Table 35 Longitudinal Cracking Performance – Low Traffic Data

| Treatment | Low | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|--------|-----|-------|-------|--------|--------|--------|----------------|----------|
| | -1 | 0 | 1 | 2 | 3 | 4 | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Two to Four Inch Overlay | 440.05 | 0 | 12.71 | 78.10 | 171.96 | 246.66 | 246.66 | 482.96 | 74.47743 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 440 | 0 | 12.71 | 78.10 | 171.96 | 246.66 | 246.66 | 482.96 | 74.47743 |

Longitudinal Cracking – Low Traffic

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

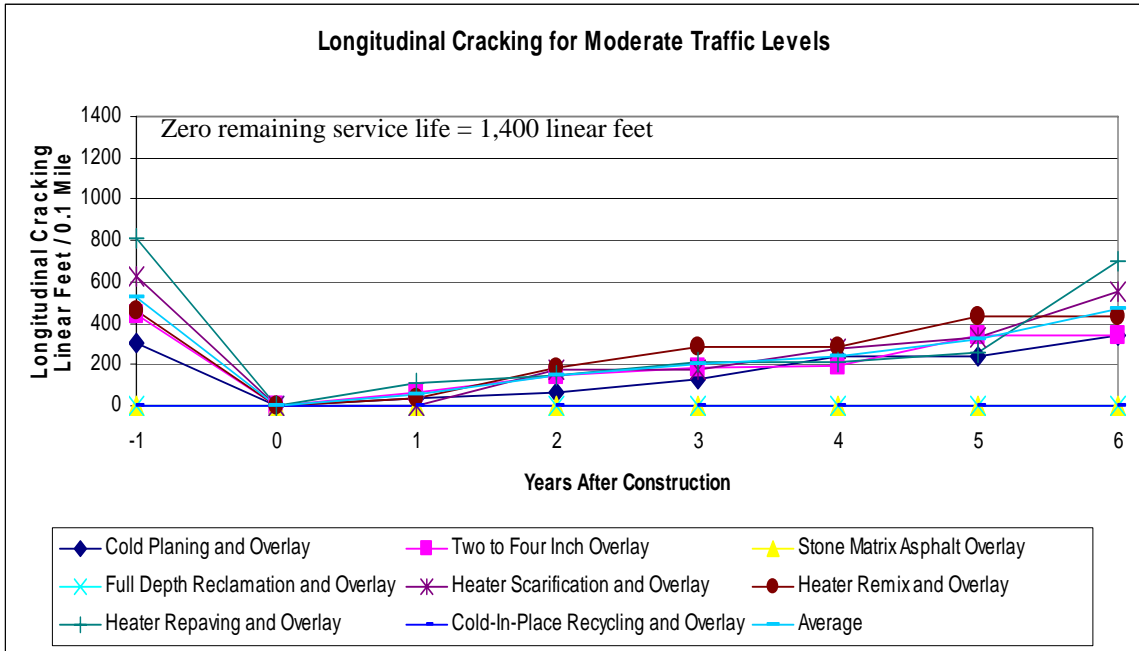


Figure 32 Longitudinal cracking performance after six years with relation to traffic counts from 0.3 to 3 million ESAL

Table 36 Traffic Longitudinal Cracking Performance – Moderate Traffic Data

| Treatment | Moderate | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|--------|--------|--------|--------|--------|--------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 300.30 | 0 | 36.38 | 66.91 | 132.46 | 242.97 | 242.97 | 344.80 | 57.9879 | 0.659 | 19.57 |
| Two to Four Inch Overlay | 446.0174 | 0 | 69.01 | 147.95 | 184.41 | 190.10 | 339.13 | 339.13 | 57.13473 | 0.595 | 24.14 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | 626.1583 | 0 | - | 175.29 | 175.29 | 276.84 | 336.02 | 554.07 | 86.99324 | 0.596 | 7.29 |
| Heater Remix and Overlay | 456 | 0 | 39.51 | 180.40 | 289.59 | 289.59 | 429.73 | 429.73 | 77.81449 | 0.739 | 4.86 |
| Heater Repaving and Overlay | 814.6 | 0 | 115.10 | 146.77 | 214.50 | 214.50 | 256.17 | 699.97 | 87.49167 | 0.8 | 2.86 |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 529 | 0 | 52.00 | 143.46 | 199.25 | 242.80 | 320.80 | 473.54 | 73.48441 | | |

Longitudinal Cracking – Moderate Traffic

Stone matrix asphalt and overlay, full-depth reclamation and overlay, and cold-in-place recycling and overlay are not represented. Both cold planing and overlay and 2 to 4-inch overlay showed the least amounts of longitudinal cracking per year than the other rehabilitation strategies. Heater scarification and overlay and heater repaving and overlay had the most amounts of longitudinal cracking per year as shown in Table 36.

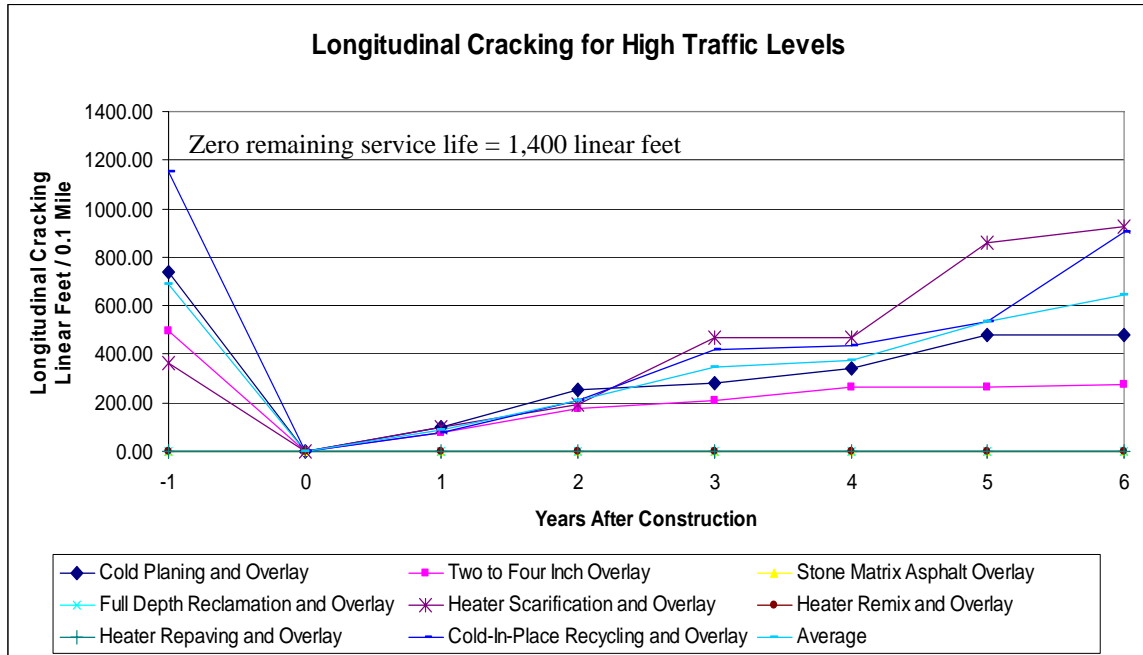


Figure 33 Longitudinal cracking performance after six years with relation to traffic counts from 3 to 11 million ESAL

Table 37 Longitudinal Cracking Performance – High Traffic Data

| Treatment | High | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|--------|-----|--------|--------|--------|--------|--------|--------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 740.91 | 0 | 101.16 | 251.89 | 279.44 | 340.04 | 478.99 | 478.99 | 81.45625 | 0.755 | 7.43 |
| Two to Four Inch Overlay | 498 | 0 | 78.45 | 179.05 | 210.65 | 264.75 | 264.75 | 277.55 | 46.10536 | 0.648 | 3.43 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | 365 | 0 | 100.77 | 192.45 | 468.65 | 468.65 | 862.48 | 925.28 | 163.409 | 0.778 | 4.14 |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | 1151.1 | 0 | 79.07 | 207.67 | 421.53 | 433.33 | 534.20 | 902.53 | 137.269 | 0.711 | 3 |
| Average | 689 | 0 | 89.86 | 207.76 | 345.07 | 376.69 | 535.10 | 646.09 | 107.0599 | | |

Longitudinal Cracking – High Traffic

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, and heater repaving and overlay are not represented. Two to 4-inch overlay showed a significantly less amount of longitudinal cracking per year than the other rehabilitation strategies. Heater scarification and overlay showed the most amounts of longitudinal cracking per year as shown in Table 37.

CUMMULATIVE INCREASE IN DISTRESSES IN RELATION WITH HIGHWAY CLASSIFICATION

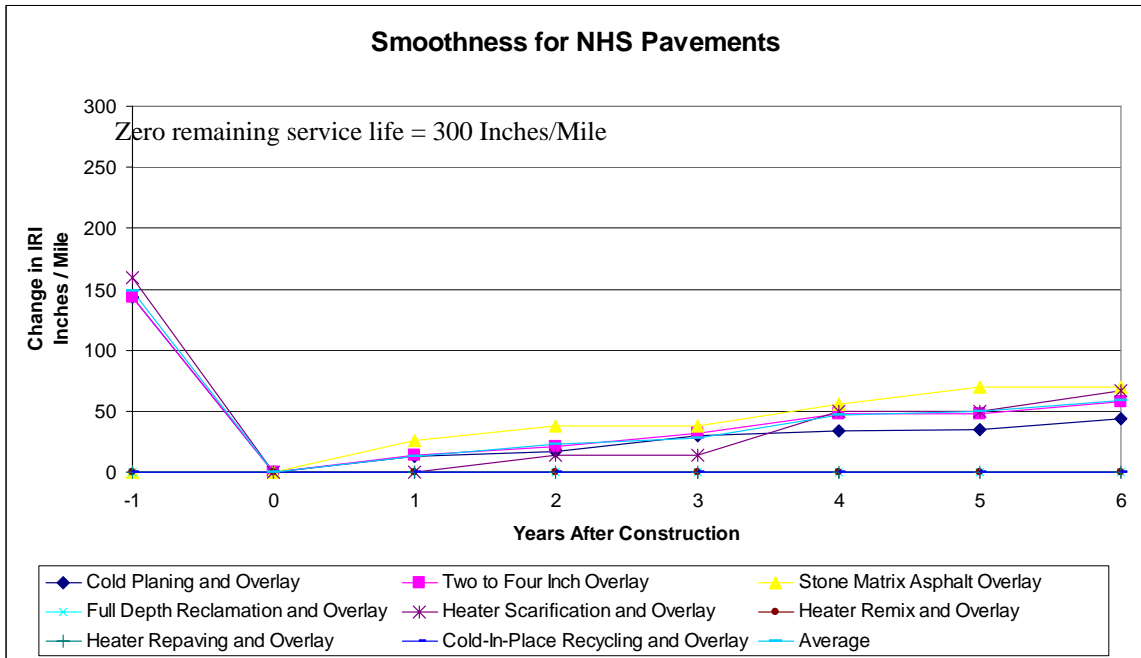


Figure 34 Rate of change for smoothness after six years relating to being located on the National Highway System (NHS)

Table 38 Smoothness Performance – NHS Data

| Treatment | NHS | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|-------|-------|-------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 143.22 | 0.00 | 12.63 | 17.34 | 29.51 | 33.71 | 34.52 | 43.39 | 6.797341 | 0.803 | 12.86 | |
| Two to Four Inch Overlay | 143.4286 | 0 | 14.23 | 21.33 | 31.94 | 47.43 | 47.43 | 57.44 | 9.457781 | 0.859 | 7.29 | |
| Stone Matrix Asphalt Overlay | ---- | 0 | 26.33 | 37.67 | 37.67 | 55.42 | 69.35 | 69.35 | 11.1369 | 0.898 | 3 | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 159.5667 | 0 | - | 13.84 | 13.84 | 50.00 | 50.00 | 66.90 | 12.03056 | 0.861 | 7.29 | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 149 | 0 | 13 | 23 | 28 | 47 | 50 | 59 | 9.855645 | | | |

Smoothness – NHS

Full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the best performance over time. Heater scarification and overlay has the worst performance over time as shown in Table 38.

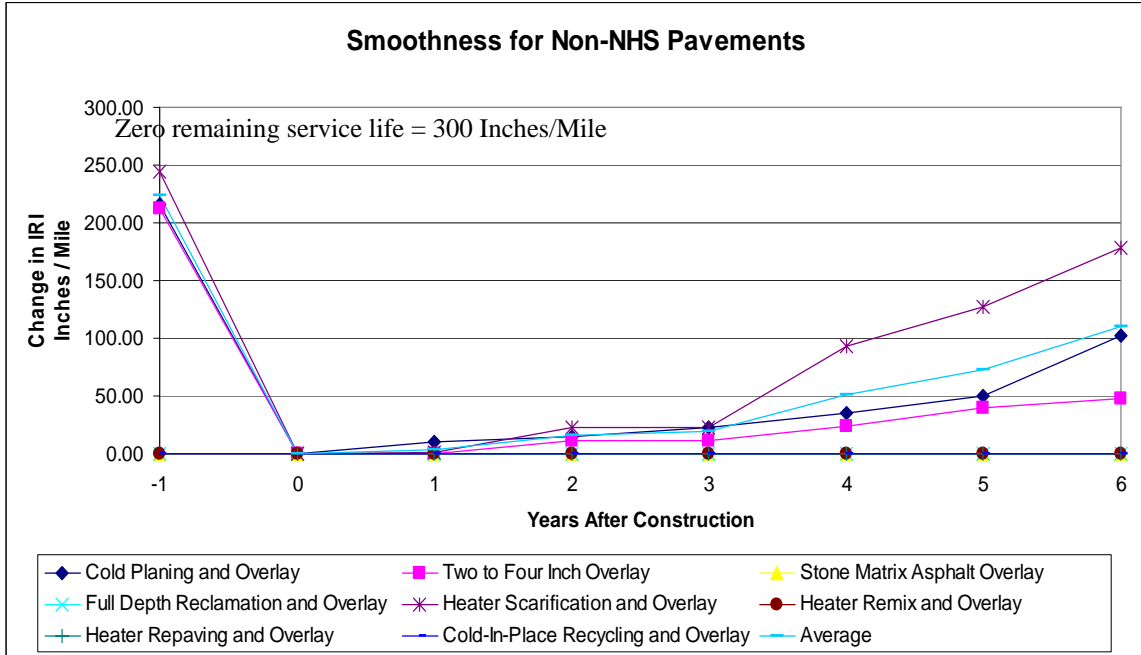


Figure 35 Rate of change for smoothness after six years relating to not being located on the National Highway System (NHS)

Table 39 Smoothness Performance – Non-NHS Data

| Treatment | Non NHS | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|-------|-------|-------|-------|--------|--------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 215.85 | 0 | 10.09 | 15.10 | 22.49 | 35.28 | 50.38 | 102.45 | 14.5756 | 0.881 | 3.57 | |
| Two to Four Inch Overlay | 212.5167 | 0 | - | 11.44 | 11.52 | 24.05 | 40.27 | 47.74 | 8.442381 | 0.796 | 16 | |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Scarification and Overlay | 244.05 | 0 | 1.61 | 22.83 | 22.83 | 92.65 | 127.13 | 178.93 | 30.62976 | 0.845 | 3.57 | |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Average | 224 | 0 | 4 | 16 | 19 | 51 | 73 | 110 | 17.88258 | | | |

Smoothness – Non-NHS

Stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch overlay showed the best performance with regards to smoothness. Heater scarification and overlay showed a significantly larger amount of distress each year than the other rehabilitation strategies as shown in Table 39.

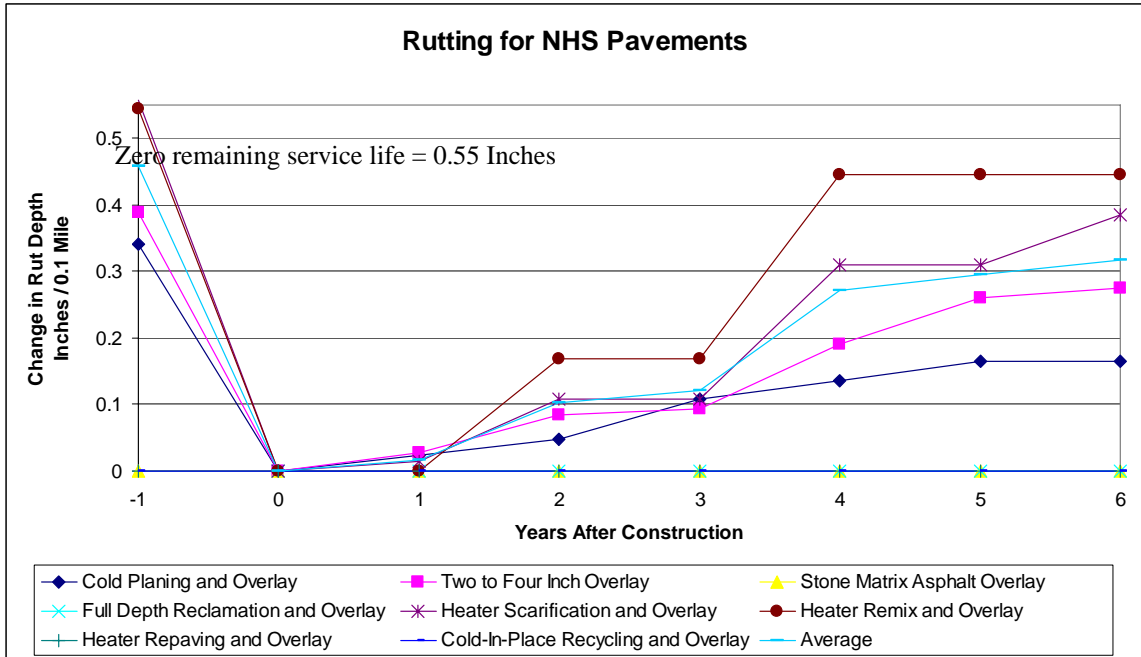


Figure 36 Permanent deformation performance after six years relating to being located on the National Highway System (NHS)

Table 40 Rutting Performance – NHS Data

| Treatment | NHS | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 0.341778 | 0.00 | 0.02 | 0.05 | 0.11 | 0.14 | 0.16 | 0.16 | 0.030905 | 0.866 | 20.71 | |
| Two to Four Inch Overlay | 0.388333 | 0 | 0.03 | 0.08 | 0.09 | 0.19 | 0.26 | 0.28 | 0.050054 | 0.683 | 26.14 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 0.557 | 0 | 0.02 | 0.11 | 0.11 | 0.31 | 0.31 | 0.38 | 0.069419 | 0.856 | 5 | |
| Heater Remix and Overlay | 0.544 | 0 | - | 0.17 | 0.17 | 0.45 | 0.45 | 0.45 | 0.089604 | 0.875 | 33 | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 0.46 | 0.00 | 0.02 | 0.10 | 0.12 | 0.27 | 0.30 | 0.32 | 0.059995 | | | |

Rutting – NHS

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of rutting per year. Heater remix and overlay showed significantly more rutting per year than the other rehabilitation strategies as shown in Table 40.

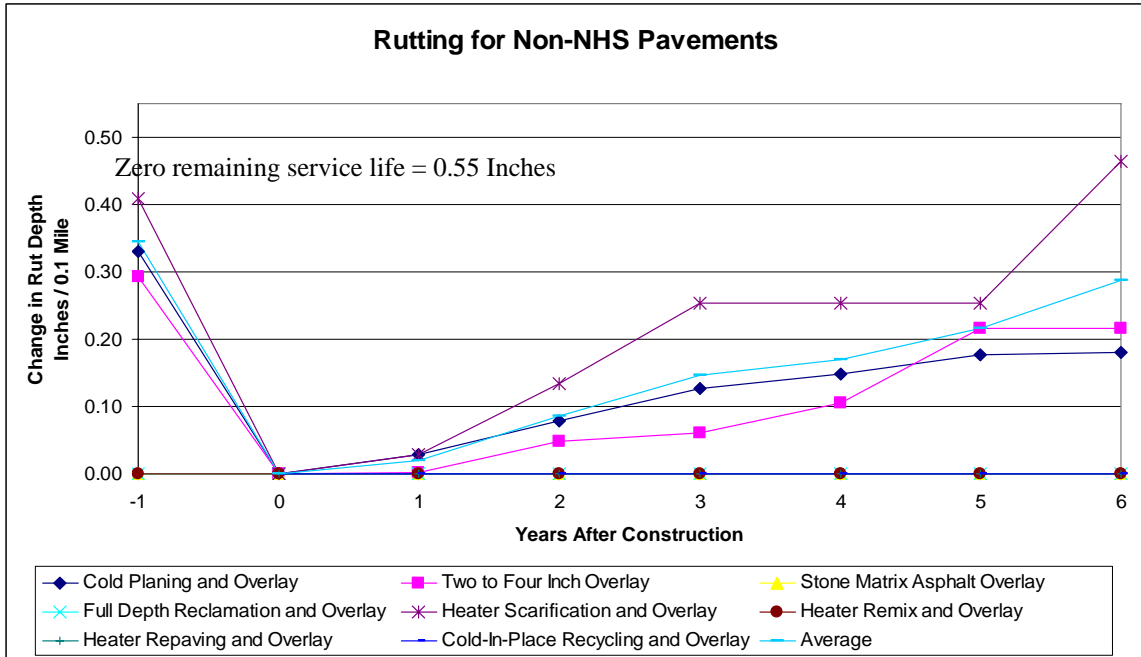


Figure 37 Permanent deformation performance after six years relating to not being located on the National Highway System (NHS)

Table 41 Rutting Performance – Non-NHS Data

| Treatment | Non NHS | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|---------|------|------|------|------|------|------|------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 0.33 | 0 | 0.03 | 0.08 | 0.13 | 0.15 | 0.18 | 0.18 | 0.03242 | 0.915 | 7 | |
| Two to Four Inch Overlay | 0.2932 | 0 | 0.00 | 0.05 | 0.06 | 0.11 | 0.22 | 0.22 | 0.040552 | 0.788 | 18.43 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 0.4084 | 0 | 0.03 | 0.13 | 0.25 | 0.25 | 0.25 | 0.47 | 0.070244 | 0.728 | 5.43 | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 0.34 | 0.00 | 0.02 | 0.09 | 0.15 | 0.17 | 0.22 | 0.29 | 0.047739 | | | |

Rutting – Non-NHS

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of rutting per year than the other rehabilitation strategies. Heater scarification and overlay showed the most amount of rutting per year as shown in Table 41.

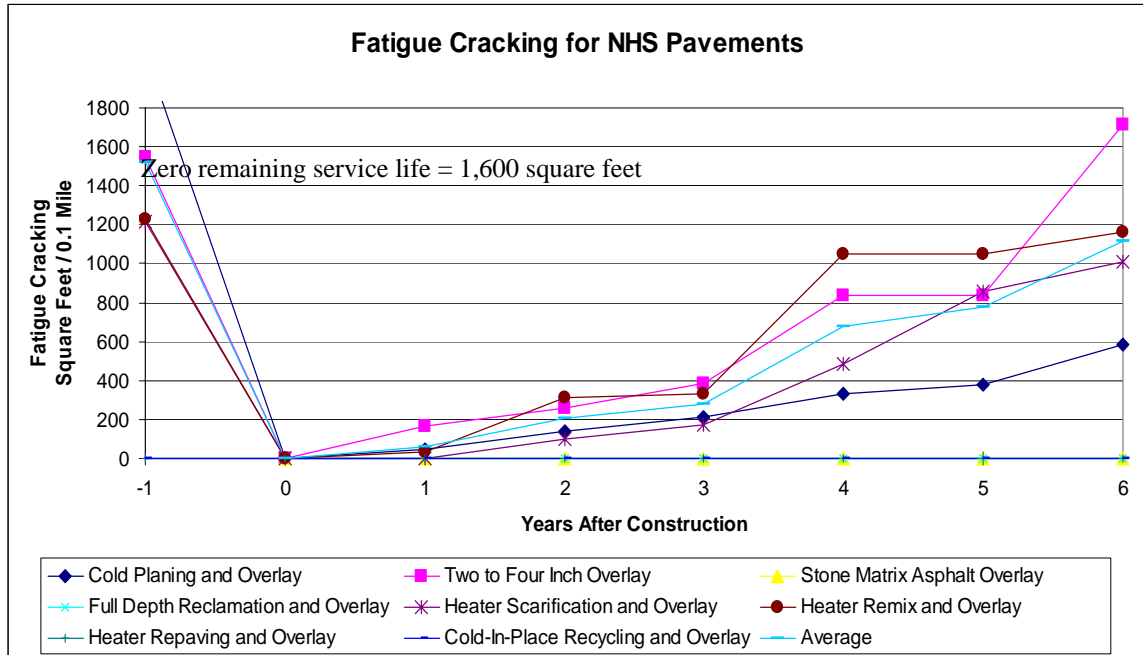


Figure 38 Fatigue cracking performance after six years relating to being located on the National Highway System (NHS)

Table 42 Fatigue Performance – NHS Data

| Treatment | NHS | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|--------|--------|--------|----------|----------|----------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 2088.01 | 0.00 | 45.13 | 142.56 | 213.80 | 334.95 | 378.45 | 581.59 | 92.99288 | 0.365 | 20.29 | |
| Two to Four Inch Overlay | 1547.695 | 0 | 163.17 | 259.27 | 385.32 | 833.86 | 833.86 | 1,710.58 | 251.7036 | 0.511 | 18.43 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 1213.65 | 0 | - | 102.11 | 174.54 | 481.87 | 860.06 | 1,010.11 | 183.2226 | 0.714 | 5.29 | |
| Heater Remix and Overlay | 1226 | 0 | 36.40 | 312.35 | 329.76 | 1,046.52 | 1,046.52 | 1,162.62 | 222.9382 | 0.659 | 3.86 | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 1518.84 | 0.00 | 61.18 | 204.07 | 275.86 | 674.30 | 779.72 | 1116.23 | 187.7143 | | | |

Fatigue – NHS

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less fatigue cracking per year than any other rehabilitation strategy. Two to 4-inch overlay showed the most amount of fatigue cracking as shown in Table 42.

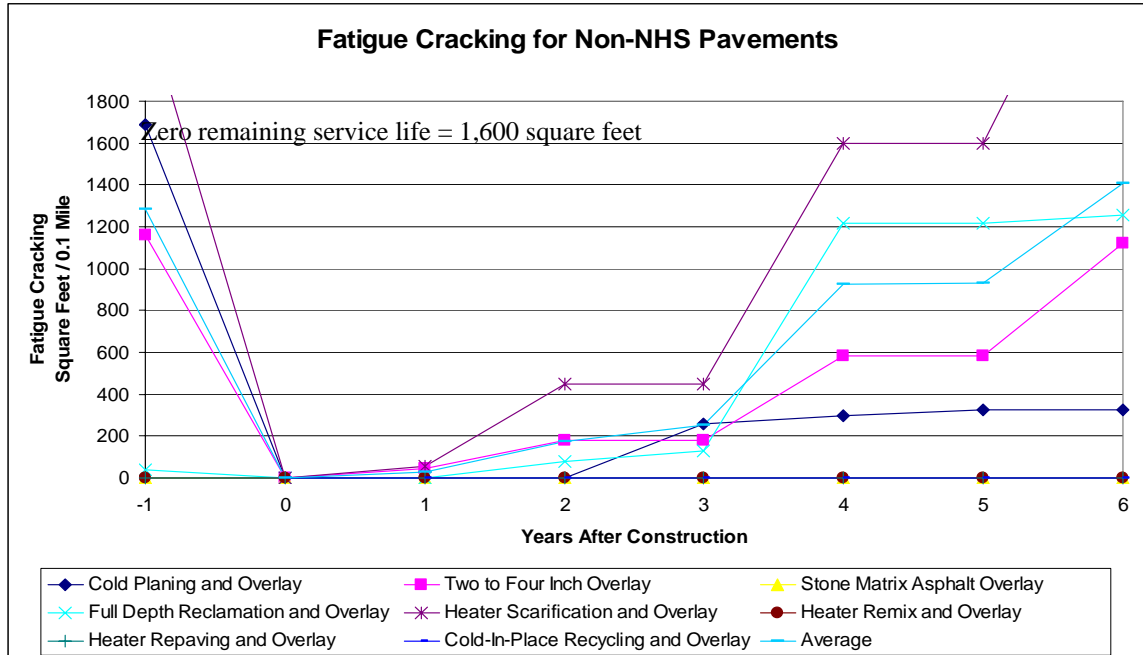


Figure 39 Fatigue cracking performance after six years relating to not being located on the National Highway System (NHS)

Table 43 Fatigue Performance – Non-NHS Data

| Treatment | Non NHS | | | | | | | | | | |
|-------------------------------------|----------|-----|-------|--------|--------|-----------|-----------|-----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Slope | R ² | n, Avg |
| Cold Planing and Overlay | 1689.575 | 0 | 0.98 | 0.98 | 256.75 | 299.19 | 323.79 | 323.79 | 68.39994 | 0.359 | 7.57 |
| Two to Four Inch Overlay | 1158.773 | 0 | 46.61 | 179.05 | 179.05 | 582.70 | 582.70 | 1,122.83 | 173.0111 | 0.353 | 25.29 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | 41.9 | 0 | 0 | 75.75 | 126.4 | 1218.6833 | 1218.6833 | 1255.9833 | 262.4375 | 0.203 | 3 |
| Heater Scarification and Overlay | 2246.9 | 0 | 55.88 | 449.04 | 449.04 | 1,599.48 | 1,599.48 | 2,920.38 | 464.2421 | 0.529 | 4.71 |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 1284 | 0 | 26 | 176 | 253 | 925 | 931 | 1406 | 242.0227 | | |

Fatigue – Non-NHS

Stone matrix asphalt overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less fatigue cracking per year when compared to the other rehabilitation strategies. Heater scarification and overlay had significantly more amounts of fatigue cracking per year than all the other rehabilitation strategies as shown in Table 43.

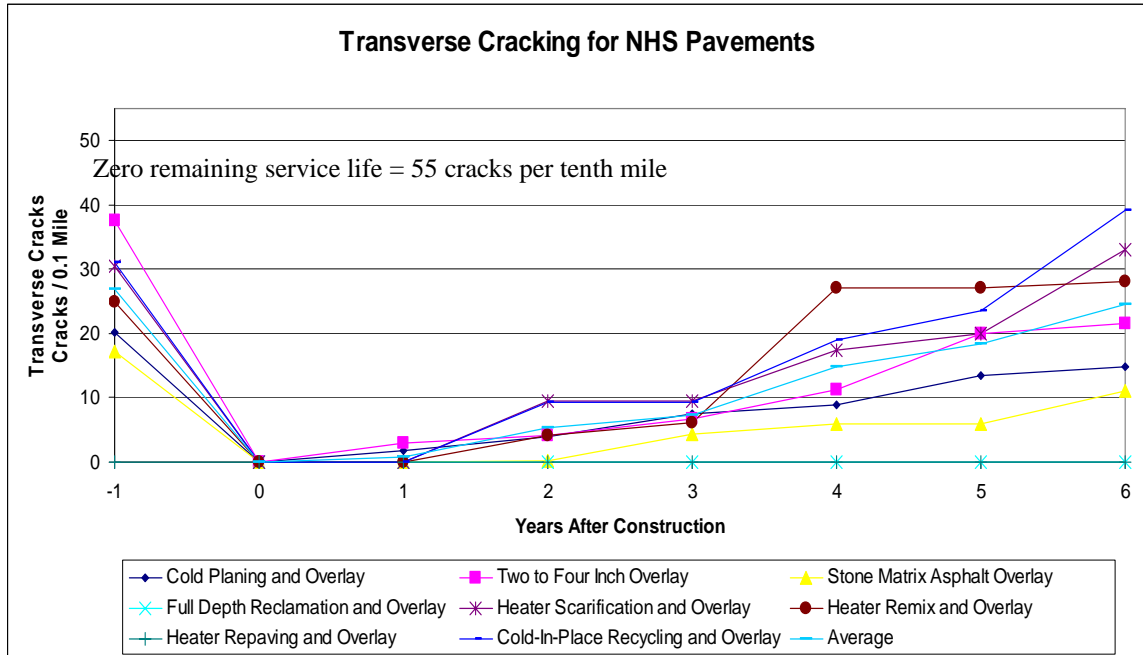


Figure 40 Transverse cracking performance after six years relating to being located on the National Highway System (NHS)

Table 44 Transverse Cracking Performance – NHS Data

| Treatment | NHS | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|----------|----------|----------|---------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 20.12857 | 0 | 1.81 | 4.05 | 7.55 | 8.86 | 13.54 | 14.77 | 2.591344 | 0.744 | 28 |
| Two to Four Inch Overlay | 37.625 | 0 | 2.89 | 4.17 | 6.67 | 11.36 | 20.04 | 21.62 | 3.798929 | 0.682 | 26.57 |
| Stone Matrix Asphalt Overlay | 17.2 | 0 | - | 0.15 | 4.40 | 5.87 | 5.87 | 11.13 | 1.816071 | 0.791 | 3 |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 30.4 | 0 | - | 9.58 | 9.58 | 17.33 | 19.96 | 32.97 | 5.235408 | 0.811 | 6.86 |
| Heater Remix and Overlay | 24.95 | 0 | - | 4.20 | 6.13 | 27.15 | 27.15 | 28.05 | 5.763776 | 0.579 | 5 |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | 31 | 0 | - | 9.37 | 9.37 | 18.95 | 23.57 | 39.10 | 6.214881 | 0.619 | 3.43 |
| Average | 26.88393 | 0 | 0.783715 | 5.251905 | 7.283199 | 14.9188 | 18.35392 | 24.60709 | 4.236735 | | |

Transverse Cracking – NHS

Full depth reclamation and overlay and heater repaving and overlay are not represented. Stone matrix asphalt overlay showed the least amount of transverse cracking than the other rehabilitation strategies. Cold-in-place recycling and overlay showed a significantly greater amount of transverse cracking than the other rehabilitation strategies as shown in Table 44.

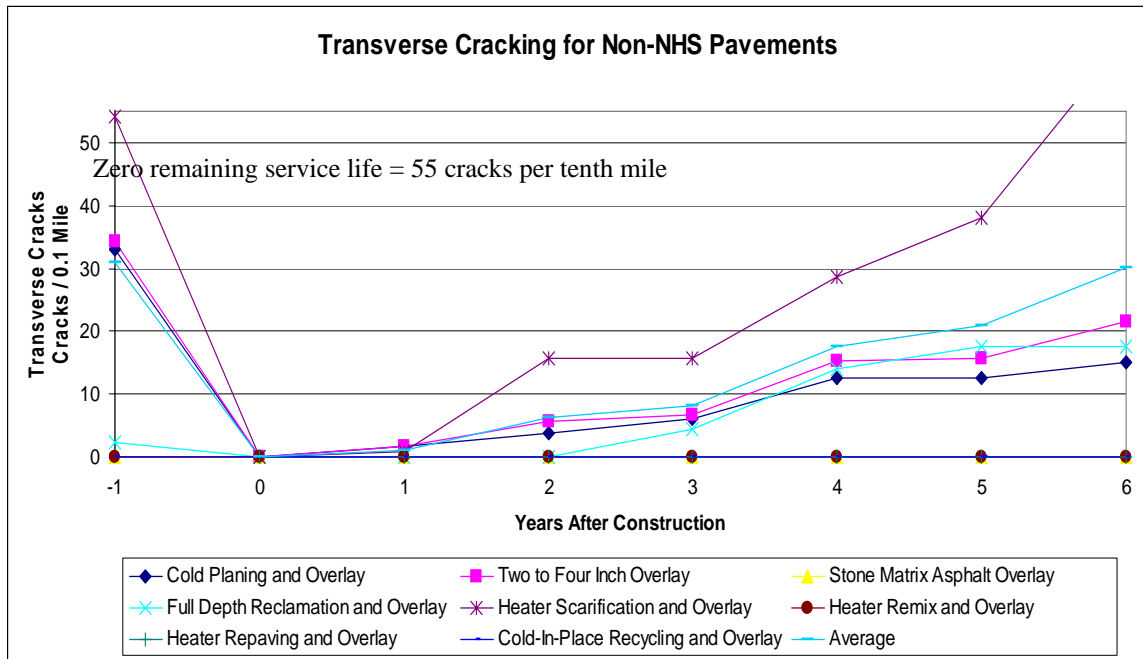


Figure 41 Transverse cracking performance after six years relating to not being located on the National Highway System (NHS)

Table 45 Transverse Cracking Performance – Non-NHS Data

| Treatment | Non NHS | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|----------|----------|----------|----------|----------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 33.01667 | 0 | 1.65 | 3.84 | 6.08 | 12.58 | 12.58 | 15.05 | 2.705078 | 0.654 | 11.57 | |
| Two to Four Inch Overlay | 34.28182 | 0 | 1.65 | 5.69 | 6.59 | 15.27 | 15.60 | 21.55 | 3.648061 | 0.695 | 30.71 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | 2.4 | 0 | 0 | 0.095238 | 4.348571 | 13.98857 | 17.49524 | 17.49524 | 3.62034 | 0.687 | 4.86 | |
| Heater Scarification and Overlay | 54.16667 | 0 | 0.87 | 15.63 | 15.63 | 28.67 | 38.04 | 66.59 | 10.25619 | 0.723 | 5.86 | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 31 | 0 | 1 | 6 | 8 | 18 | 21 | 30 | 5.057417 | | | |

Transverse Cracking – Non-NHS

Stone matrix asphalt overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Heater scarification and overlay showed a significantly more amount of transverse cracking per year when compared to the other rehabilitation strategies as shown in Table 45.

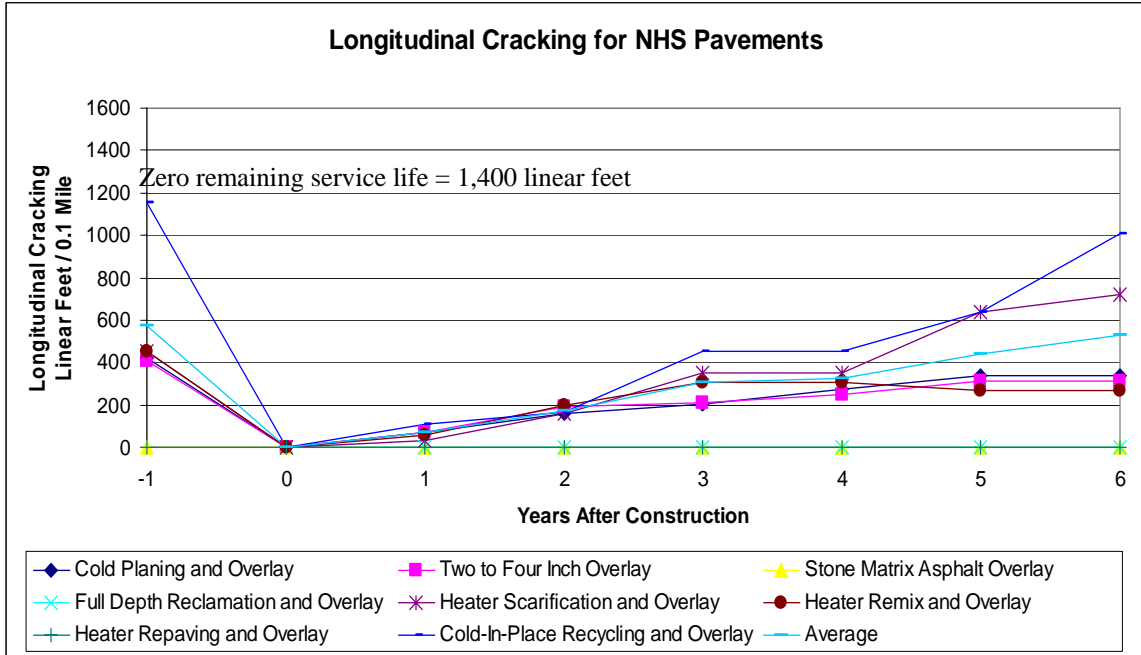


Figure 42 Longitudinal cracking performance after six years relating to being located on the National Highway System (NHS)

Table 46 Longitudinal Cracking Performance – NHS Data

| Treatment | NHS | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|----------|----------|----------|---------|---------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 418.5 | 0 | 67.02 | 160.45 | 205.64 | 275.92 | 335.72 | 335.72 | 59.28639 | 0.707 | 21.29 |
| Two to Four Inch Overlay | 406.5895 | 0 | 73.26 | 191.00 | 210.94 | 246.58 | 309.79 | 309.79 | 52.0714 | 0.682 | 17.29 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 452.35 | 0 | 34.16 | 159.28 | 349.32 | 349.32 | 639.37 | 721.62 | 127.3317 | 0.713 | 5.43 |
| Heater Remix and Overlay | 450.5 | 0 | 54.68 | 197.44 | 307.31 | 307.31 | 269.67 | 269.67 | 48.17405 | 0.772 | 4.43 |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | 1151.1 | 0 | 110.05 | 162.80 | 452.52 | 452.52 | 639.85 | 1,008.18 | 156.2095 | 0.703 | 3.43 |
| Average | 575.8079 | 0 | 67.83375 | 174.1953 | 305.1446 | 326.327 | 438.879 | 528.9957 | 88.61462 | | |

Longitudinal Cracking – NHS

Stone matrix asphalt overlay, full-depth reclamation and overlay, and heater repaving and overlay are not represented. Heater remix and overlay showed the least amount of longitudinal cracking per year when compared with the other rehabilitation strategies. Cold-in-place recycling and overlay showed the greatest amount of longitudinal cracking per year as shown in Table 46.

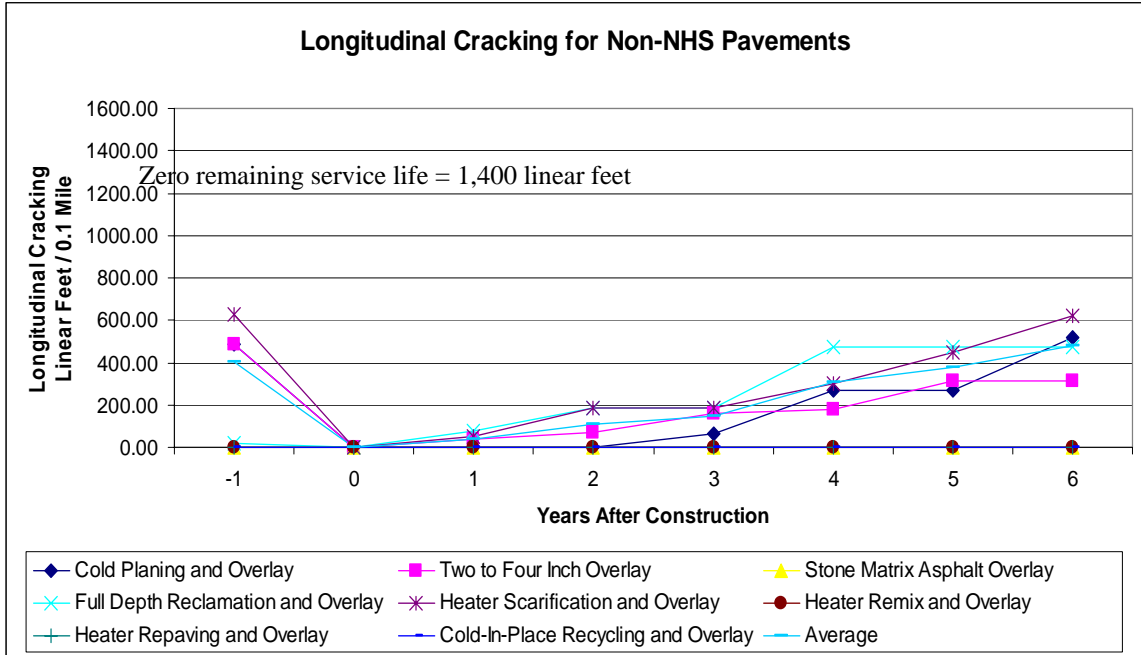


Figure 43 Longitudinal cracking performance after six years relating to not being located on the National Highway System (NHS)

Table 47 Longitudinal Cracking Performance – Non-NHS Data

| Treatment | Non NHS | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|-------|--------|--------|----------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 488.40 | 0 | - | - | 66.83 | 265.87 | 265.87 | 516.52 | 83.82679 | 0.582 | 5.71 |
| Two to Four Inch Overlay | 489.4333 | 0 | 39.47 | 70.15 | 159.37 | 181.22 | 315.73 | 315.73 | 57.52882 | 0.546 | 19.43 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | 20.6 | 0 | 76 | 185.4 | 185.4 | 474.8667 | 474.8667 | 474.8667 | 89.70714 | 0.423 | 3.57 |
| Heater Scarification and Overlay | 626.4083 | 0 | 48.46 | 184.35 | 184.35 | 302.87 | 450.45 | 619.25 | 99.2954 | 0.586 | 6.43 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 406 | 0 | 40.98 | 109.97 | 148.99 | 306.21 | 376.73 | 481.59 | 82.58954 | | |

Longitudinal Cracking – Non-NHS

Stone matrix asphalt overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch overlay showed the least amount of longitudinal cracking per year. Heater scarification and overlay showed the greatest amount of longitudinal cracking per year when compared to other rehabilitation strategies. The coefficient of determination shows that the slopes are not a good representation of the data overall as shown in Table 47.

CUMULATIVE INCREASE IN DISTRESSES OVER TIME WITH RELATION TO HIGHWAY GRADATION

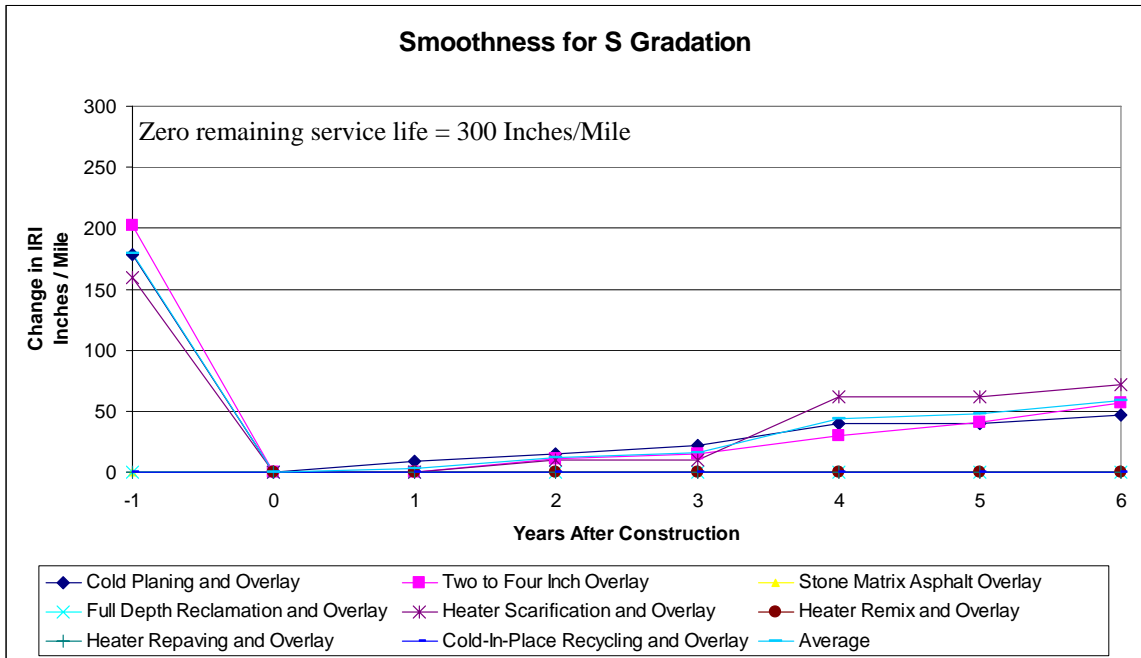


Figure 44 Rate of change for smoothness after six years with relation to having an aggregate size of no greater than 1 inch in diameter

Table 48 Smoothness Performance – S Data

| Treatment | S | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|-------|-------|-------|-------|-------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | 178.34 | 0.00 | 8.53 | 14.92 | 21.92 | 39.63 | 39.63 | 46.95 | 8.135206 | 0.798 | 10.86 | | |
| Two to Four Inch Overlay | 201.8889 | 0 | - | 10.89 | 15.30 | 30.30 | 40.53 | 57.15 | 9.712063 | 0.817 | 13.71 | | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Scarification and Overlay | 159.1667 | 0 | - | 10.01 | 10.01 | 62.27 | 62.27 | 72.26 | 14.05644 | 0.844 | 8 | | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Average | 180 | 0 | 3 | 12 | 16 | 44 | 47 | 59 | 10.63457 | | | | |

Smoothness – S

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the best performance per year when compared to the other rehabilitation strategies. Heater scarification and overlay showed the worst performance per year as shown in Table 48.

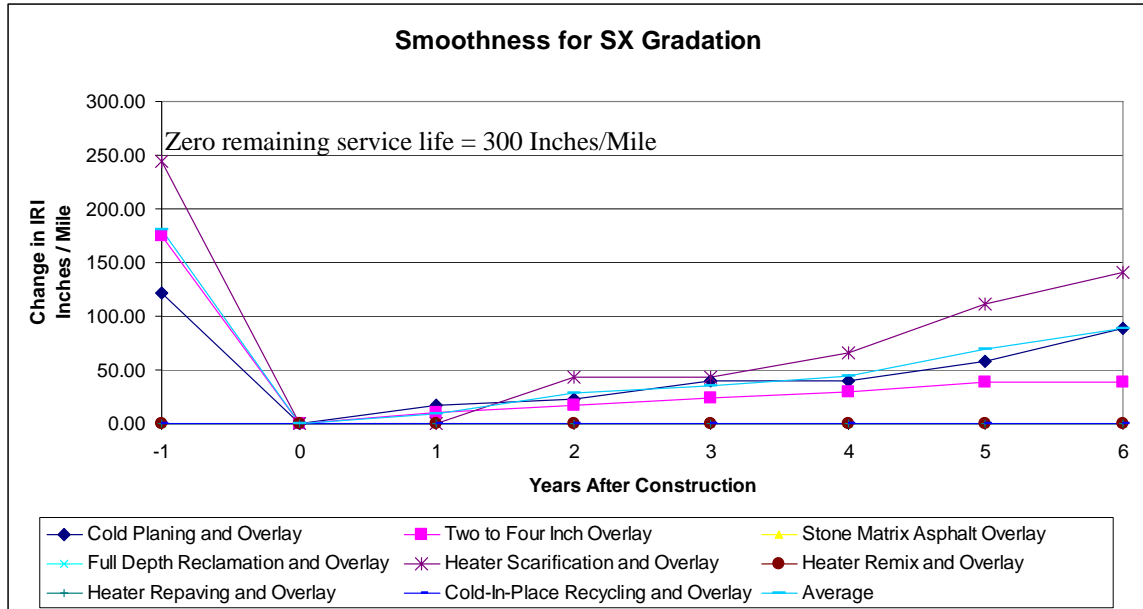


Figure 45 Rate of change for smoothness after six years with relation to having an aggregate size of no greater than 0.75 inch diameter

Table 49 Smoothness Performance - SX Data

| Treatment | SX | | | | | | Slope | R ² | n, Avg | | |
|-------------------------------------|--------|------|-------|-------|-------|-------|--------|----------------|----------|-------|------|
| | -1 | 0 | 1 | 2 | 3 | 4 | | | | | |
| Cold Planing and Overlay | 121.90 | 0 | 16.83 | 22.83 | 39.36 | 39.36 | 57.50 | 88.68 | 12.99643 | 0.834 | 5.43 |
| Two to Four Inch Overlay | 175.4 | 0 | 9.83 | 17.46 | 24.06 | 29.54 | 38.38 | 38.38 | 6.582937 | 0.813 | 9.43 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 244.65 | 0 | - | 43.35 | 43.35 | 65.55 | 111.72 | 140.35 | 23.81012 | 0.818 | 2.86 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 181 | 0 | 9 | 28 | 36 | 45 | 69 | 89 | 14.46316 | | |

Smoothness – SX

Stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed the best performance per year. Heater scarification and overlay showed the worst performance per year when compared to the other rehabilitation strategies as shown in Table 49.

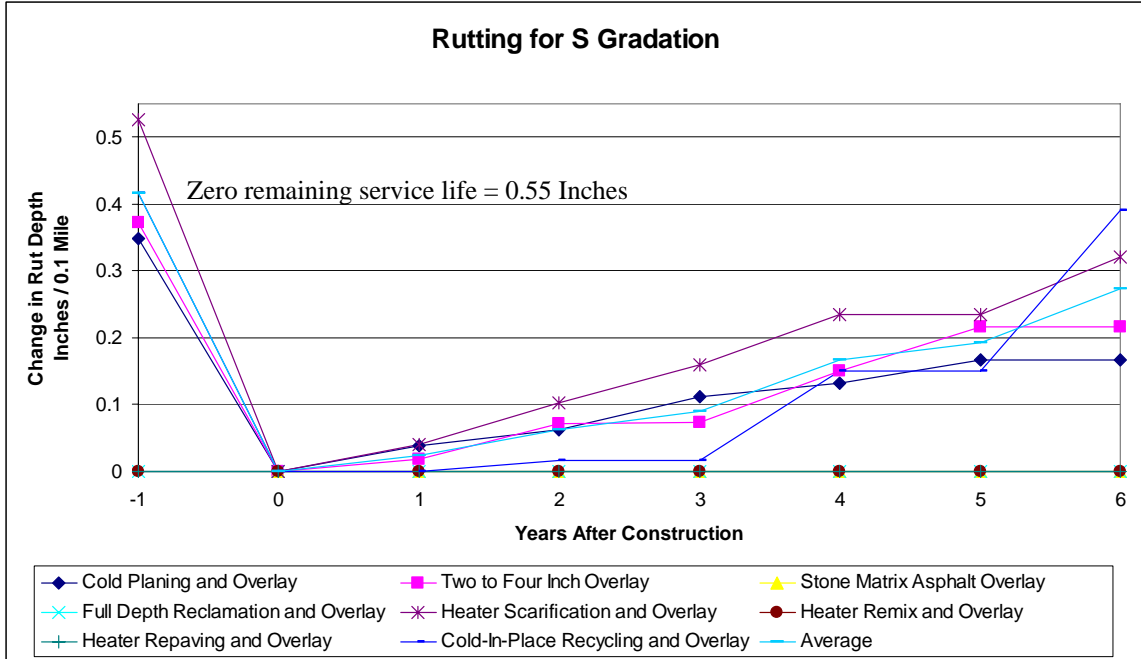


Figure 46 Permanent deformation performance after six year with relation to having an aggregate size of no greater than 1 inch in diameter

Table 50 Rutting Performance – S Data

| Treatment | S | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|---------|------|------|------|------|------|------|------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 0.34776 | 0.00 | 0.04 | 0.06 | 0.11 | 0.13 | 0.17 | 0.17 | 0.029711 | 0.841 | 26.71 | |
| Two to Four Inch Overlay | 0.373 | 0 | 0.02 | 0.07 | 0.07 | 0.15 | 0.22 | 0.22 | 0.040089 | 0.814 | 24 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 0.527 | 0 | 0.04 | 0.10 | 0.16 | 0.24 | 0.24 | 0.32 | 0.053026 | 0.773 | 8 | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | 0.4155 | 0 | - | 0.02 | 0.02 | 0.15 | 0.15 | 0.39 | 0.057375 | 0.908 | 3 | |
| Average | 0.42 | 0.00 | 0.02 | 0.06 | 0.09 | 0.17 | 0.19 | 0.27 | 0.04505 | | | |

Rutting – S

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, and heater repaving and overlay are not represented. Cold planing and overlay showed the least amount of rutting per year. Both heater scarification and overlay, and cold-in-place recycling and overlay have a similar rate of rutting per year and performed the worst as shown in Table 50.

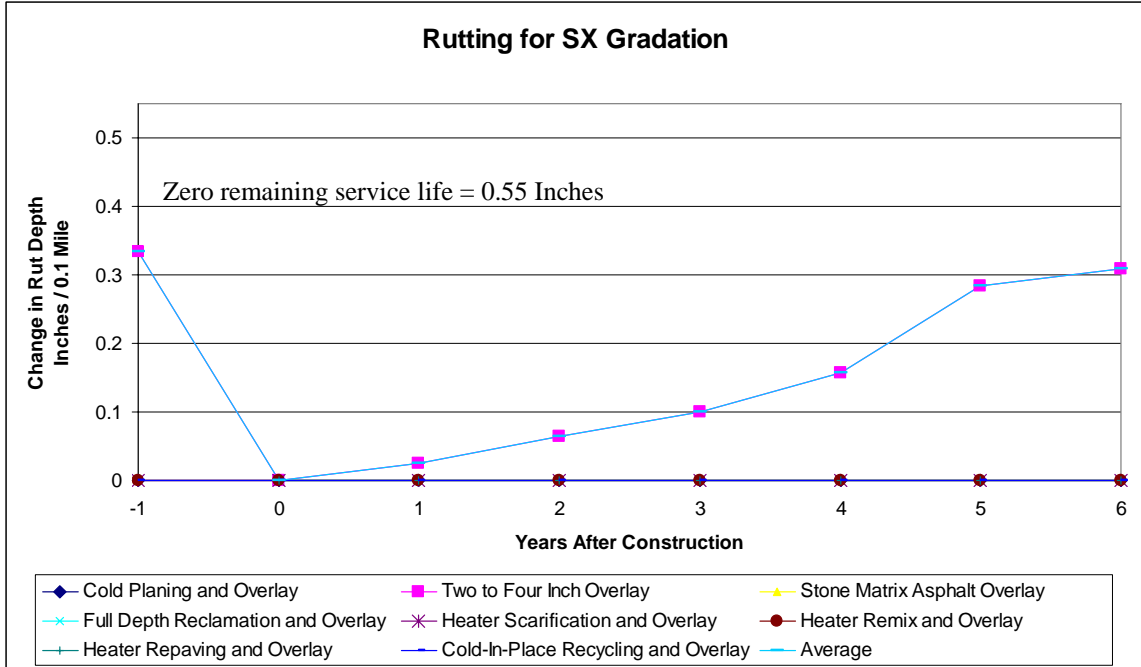


Figure 47 Permanent deformation performance after six years with relation to having an aggregate size of no greater than 0.75 inch diameter

Table 51 Rutting Performance – SX Data

| Treatment | SX | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Two to Four Inch Overlay | 0.333524 | 0.00 | 0.03 | 0.06 | 0.10 | 0.16 | 0.28 | 0.31 | 0.054829 | 0.659 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 0.33 | 0.00 | 0.03 | 0.06 | 0.10 | 0.16 | 0.28 | 0.31 | 0.054829 | |

Rutting – SX

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done as shown in Table 51.

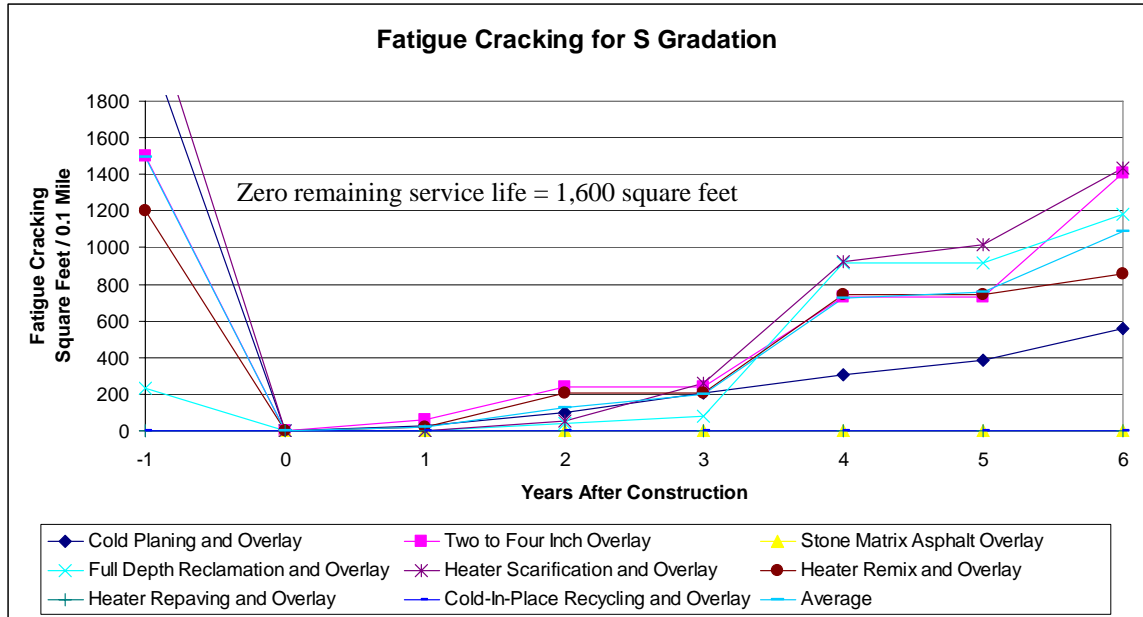


Figure 48 Fatigue cracking performance after six years with relation to having an aggregate size of no greater than 1 inch in diameter

Table 52 Fatigue Performance – S Data

| Treatment | S | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|-------|--------|--------|--------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 2151.475 | 0.00 | 25.81 | 102.51 | 203.97 | 307.65 | 382.64 | 555.56 | 92.33872 | 0.498 | 25.14 |
| Two to Four Inch Overlay | 1499.867 | 0 | 58.74 | 240.91 | 240.91 | 729.14 | 729.14 | 1,410.49 | 216.446 | 0.321 | 24.14 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | 234.8 | 0 | - | 41.36 | 80.04 | 917.24 | 917.24 | 1,184.77 | 223.7386 | 0.202 | 4 |
| Heater Scarification and Overlay | 2389.28 | 0 | - | 52.94 | 258.98 | 922.84 | 1,018.14 | 1,433.06 | 257.3343 | 0.642 | 7.29 |
| Heater Remix and Overlay | 1199.2 | 0 | 19.13 | 204.53 | 204.53 | 741.87 | 741.87 | 857.97 | 162.7393 | 0.76 | 2.71 |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 1494.92 | 0.00 | 20.74 | 128.45 | 197.69 | 723.75 | 757.81 | 1088.37 | 190.5194 | | |

Fatigue – S

Stone matrix asphalt overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less amounts of fatigue cracking each year when compared to the other rehabilitation strategies. Heater scarification and overlay showed the greatest amount of fatigue cracking per year. The coefficient of determination shows that the slope is not a good representation of the data as a whole as shown in Table 52.

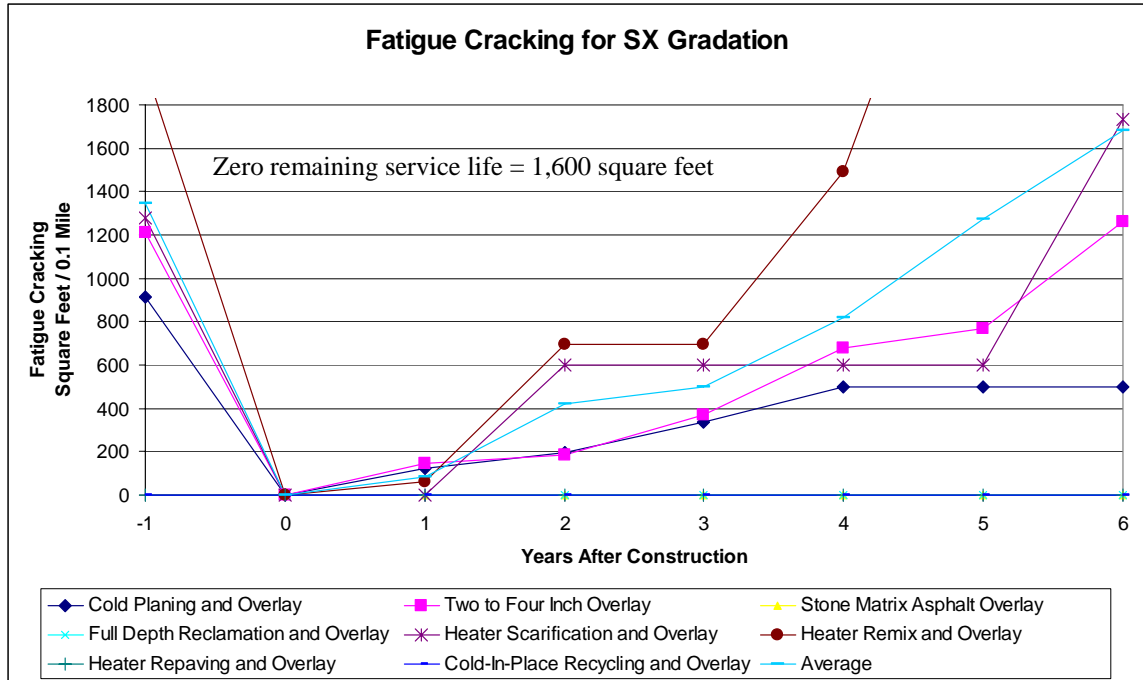


Figure 49 Fatigue cracking performance after six years with relation to having an aggregate size of no greater than 0.75 inch diameter

Table 53 Fatigue Performance – SX Data

| Treatment | SX | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|--------|--------|--------|----------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 915.75 | 0 | 124.83 | 195.60 | 335.53 | 496.53 | 496.53 | 501.13 | 90.99048 | 0.457 | 2.71 |
| Two to Four Inch Overlay | 1213.113 | 0 | 144.26 | 187.14 | 369.10 | 680.81 | 768.03 | 1,262.05 | 197.4055 | 0.552 | 19.57 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | 1277.92 | 0 | - | 600.95 | 600.95 | 600.95 | 600.95 | 1,733.05 | 228.6089 | 0.65 | 2.71 |
| Heater Remix and Overlay | 1971.15 | 0 | 58.93 | 692.93 | 692.93 | 1,491.73 | 3,235.53 | 3,235.53 | 602.0934 | 0.597 | 2.71 |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 1344 | 0 | 82 | 419 | 500 | 818 | 1275 | 1683 | 279.7746 | | |

Fatigue – SX

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed a significantly less amount of fatigue cracking per year than the other rehabilitation strategies. Heater remix and overlay showed significantly greater amounts of fatigue cracking when compared to the other rehabilitation strategies as shown in Table 53.

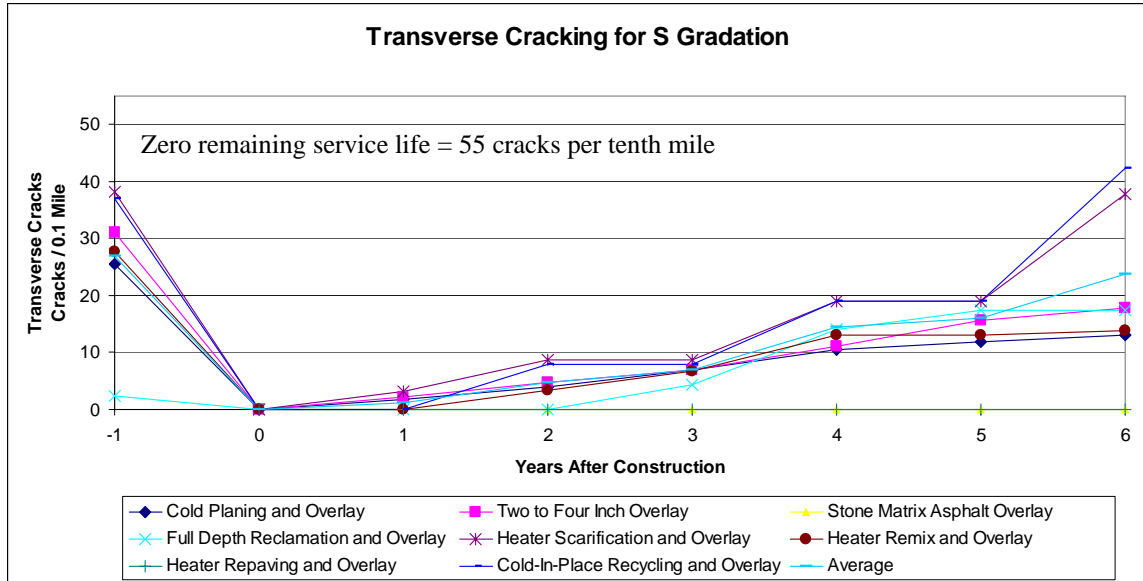


Figure 50 Transverse cracking performance after six years with relation to having an aggregate size of no greater than 1 inch in diameter

Table 54 Transverse Cracking Performance – S Data

| Treatment | S | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|----------|---------|----------|----------|----------|----------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 25.50286 | 0 | 1.74 | 3.97 | 6.94 | 10.45 | 11.93 | 13.14 | 2.367002 | 0.708 | 36 | |
| Two to Four Inch Overlay | 31.13684 | 0 | 2.14 | 4.76 | 6.89 | 11.06 | 15.70 | 17.74 | 3.094635 | 0.761 | 30.86 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | 2.4 | 0 | - | 0.10 | 4.35 | 13.99 | 17.50 | 17.50 | 3.62034 | 6.87 | 4.86 | |
| Heater Scarification and Overlay | 38.14286 | 0 | 3.19 | 8.74 | 8.74 | 19.04 | 19.04 | 37.71 | 5.539913 | 0.809 | 9 | |
| Heater Remix and Overlay | 27.7 | 0 | - | 3.40 | 6.65 | 13.00 | 13.00 | 13.90 | 2.760714 | 0.908 | 13.43 | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | 36.93333 | 0 | - | 7.93 | 7.93 | 18.93 | 18.93 | 42.33 | 6.280357 | 0.595 | 4.43 | |
| Average | 26.96931 | 0 | 1.178169 | 4.81543 | 6.915755 | 14.41066 | 16.01577 | 23.71891 | 3.943827 | | | |

Transverse Cracking – S

Stone matrix asphalt overlay, and heater repaving and overlay are not represented.

Both cold planing and overlay and heater remix and overlay have the least amounts of transverse cracking per year. Cold-in-place recycling and overlay showed the greatest amount of transverse cracking per year as shown in Table 54.

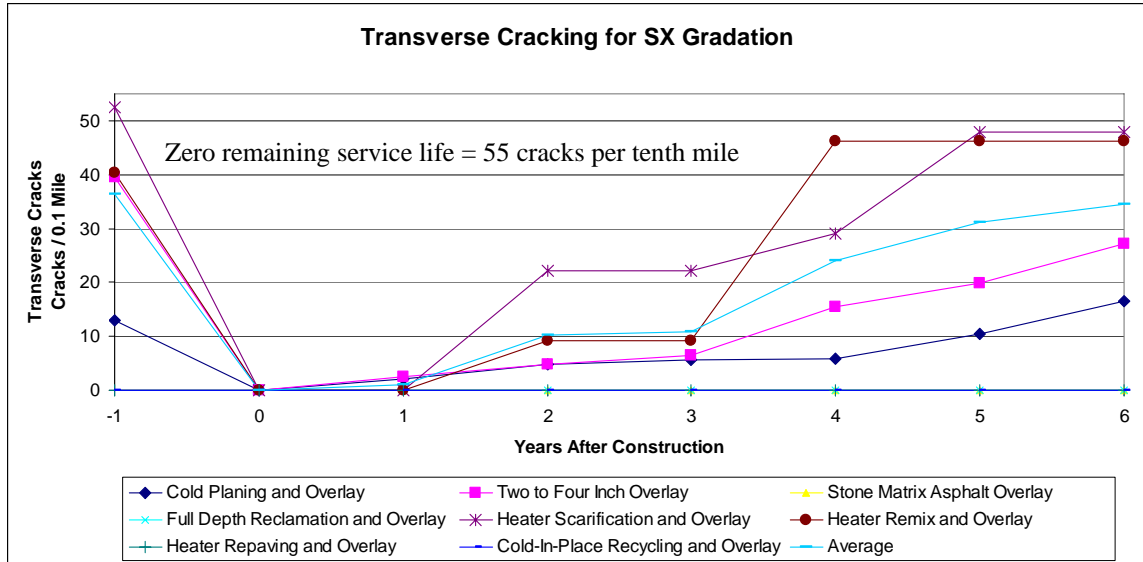


Figure 51 Transverse cracking performance after six years with relation to having an aggregate size of no greater than 0.75 inch diameter

Table 55 Transverse Cracking Performance – SX Data

| Treatment | SX | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|-------|-------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 12.86667 | 0 | 2.04 | 4.80 | 5.72 | 5.84 | 10.38 | 16.48 | 2.398571 | 0.758 | 4.14 | |
| Two to Four Inch Overlay | 39.46667 | 0 | 2.51 | 4.80 | 6.43 | 15.47 | 19.93 | 27.25 | 4.544367 | 0.689 | 26.43 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 52.5 | 0 | - | 22.13 | 22.13 | 29.13 | 47.83 | 47.83 | 8.791667 | 0.748 | 3.71 | |
| Heater Remix and Overlay | 40.35 | 0 | - | 9.23 | 9.23 | 46.15 | 46.15 | 46.15 | 9.560238 | 0.611 | 2.71 | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 36 | 0 | 1 | 10 | 11 | 24 | 31 | 34 | 6.323711 | | | |

Transverse Cracking – SX

Stone matrix asphalt overlay, full depth reclamation and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less amounts of transverse cracking than the other rehabilitation strategies. Heater remix and overlay showed the greatest amount of transverse cracking per year as shown in Table 55.

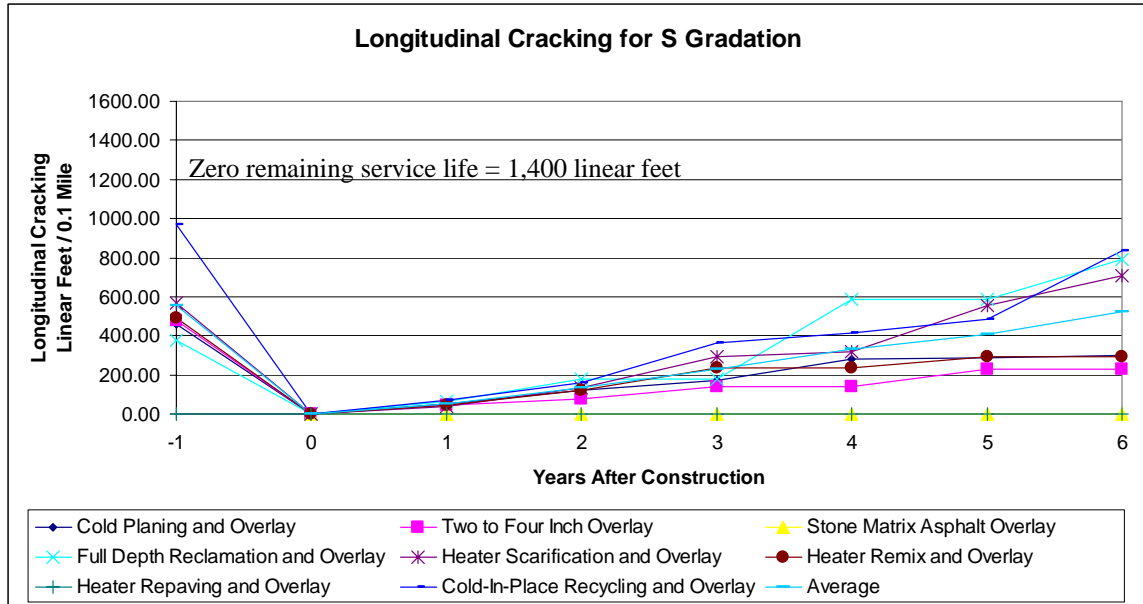


Figure 52 Longitudinal cracking performance after six years with relation to having an aggregate size of no greater than 1 inch in diameter

Table 56 Longitudinal Cracking Performance – S Data

| Treatment | S | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|----------|----------|----------|----------|----------|----------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 460.47 | 0 | 52.90 | 121.53 | 171.33 | 280.67 | 288.45 | 298.65 | 54.50697 | 0.681 | 25.14 | |
| Two to Four Inch Overlay | 480.3714 | 0 | 46.68 | 76.49 | 140.80 | 140.80 | 229.85 | 229.85 | 40.00758 | 0.468 | 17.14 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | 378.8 | 0 | 66.63 | 177.96 | 177.96 | 584.41 | 584.41 | 789.41 | 136.0798 | 0.523 | 4.57 | |
| Heater Scarification and Overlay | 569.0667 | 0 | 39.96 | 133.31 | 295.65 | 319.72 | 552.00 | 705.84 | 118.8573 | 0.706 | 9 | |
| Heater Remix and Overlay | 488.2 | 0 | 41.73 | 123.33 | 238.93 | 238.93 | 293.07 | 293.07 | 53.48095 | 0.809 | 2.71 | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | 969.5333 | 0 | 70.46 | 160.44 | 360.56 | 414.48 | 483.36 | 836.11 | 128.1489 | 0.659 | 4.43 | |
| Average | 557.7401 | 0 | 53.06005 | 132.1766 | 230.8724 | 329.8366 | 405.1899 | 525.4868 | 88.51358 | | | |

Longitudinal Cracking – S

Stone matrix asphalt overlay, and heater repaving and overlay are not represented.

Both 2 to 4 inch overlay and cold planing and overlay showed the least amount of longitudinal cracking per year. Both full depth reclamation and overlay, and cold-in-place recycling and overlay showed the greatest amounts of longitudinal cracking per year as shown in Table 56.

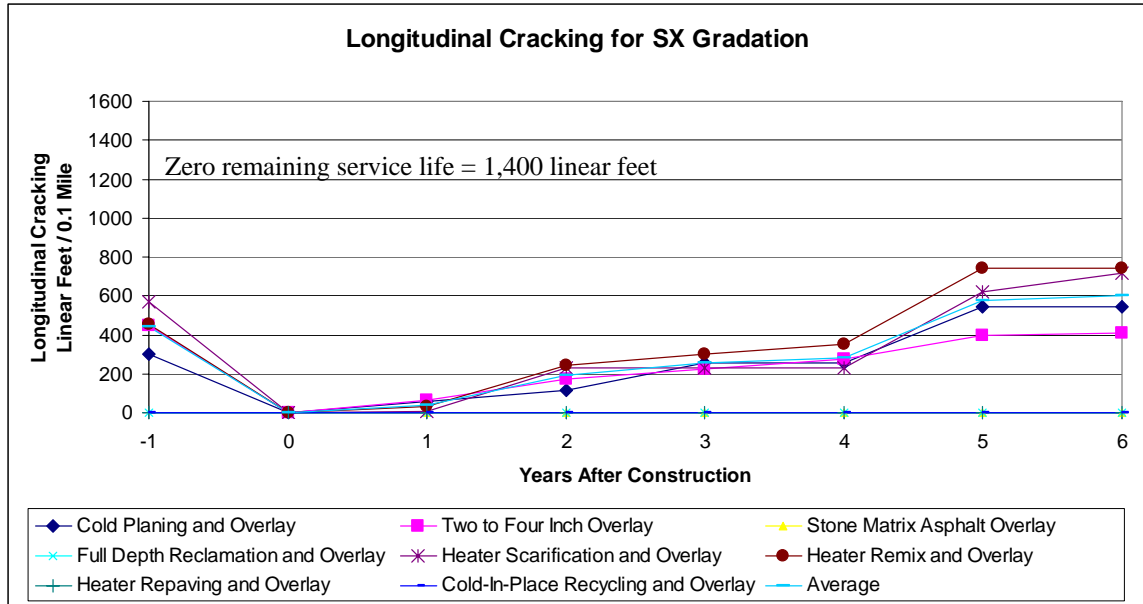


Figure 53 Longitudinal cracking performance after six years with relation to having an aggregate size of no greater than 0.75 inch diameter

Table 57 Longitudinal Cracking Performance – SX Data

| Treatment | SX | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|--------|------|-------|--------|--------|--------|--------|--------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 303.76 | 0 | 56.60 | 115.05 | 255.00 | 255.00 | 542.40 | 542.40 | 97.8125 | 0.514 | 2.86 | |
| Two to Four Inch Overlay | 445.1 | 0 | 63.53 | 174.57 | 226.20 | 278.17 | 398.09 | 406.72 | 71.17396 | 0.752 | 19.29 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 567.44 | 0 | 9.27 | 229.79 | 229.79 | 229.79 | 619.09 | 719.79 | 120.6786 | 0.598 | 2.86 | |
| Heater Remix and Overlay | 456 | 0 | 33.10 | 243.40 | 300.64 | 352.75 | 740.20 | 740.20 | 133.7196 | 0.861 | 2.86 | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 443 | 0 | 40.62 | 190.70 | 252.91 | 278.93 | 574.94 | 602.28 | 105.8462 | | | |

Longitudinal Cracking – SX

Stone matrix asphalt overlay, full depth reclamation and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch overlay showed the least amount of longitudinal cracking per year. Heater remix and overlay showed significantly more longitudinal cracking per year when compared with the other rehabilitation strategies as shown in Table 57.

CUMMULATIVE INCREASE IN DISTRESSES WITH RELATION TO REGION

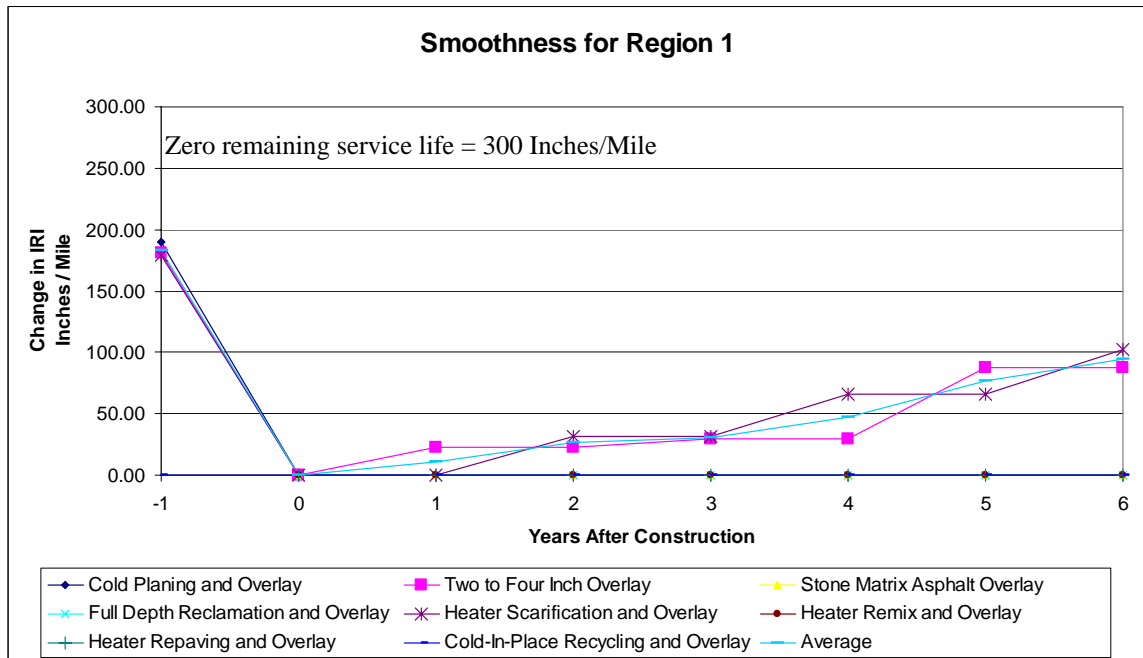


Figure 54 Rate of change for smoothness after six years in relation to Region 1

Table 58 Smoothness Performance – Region 1 Data

| Treatment | Region 1 | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | 189.56 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 180.8 | 0 | 22 | 22 | 29 | 29 | 87 | 87 | 14.27041 | 0.794 | 4.29 | ---- | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 178.5667 | 0 | 0 | 31 | 31 | 66 | 66 | 102 | 16.82214 | 0.817 | 7 | ---- | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 183 | 0 | 11 | 27 | 30 | 47 | 76 | 95 | 15.54628 | ---- | ---- | ---- | |

Smoothness – Region 1

Cold planing and overlay, stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch and heater scarification and overlay are the only two rehabilitation strategies represented and both performed similarly as shown in Table 58.

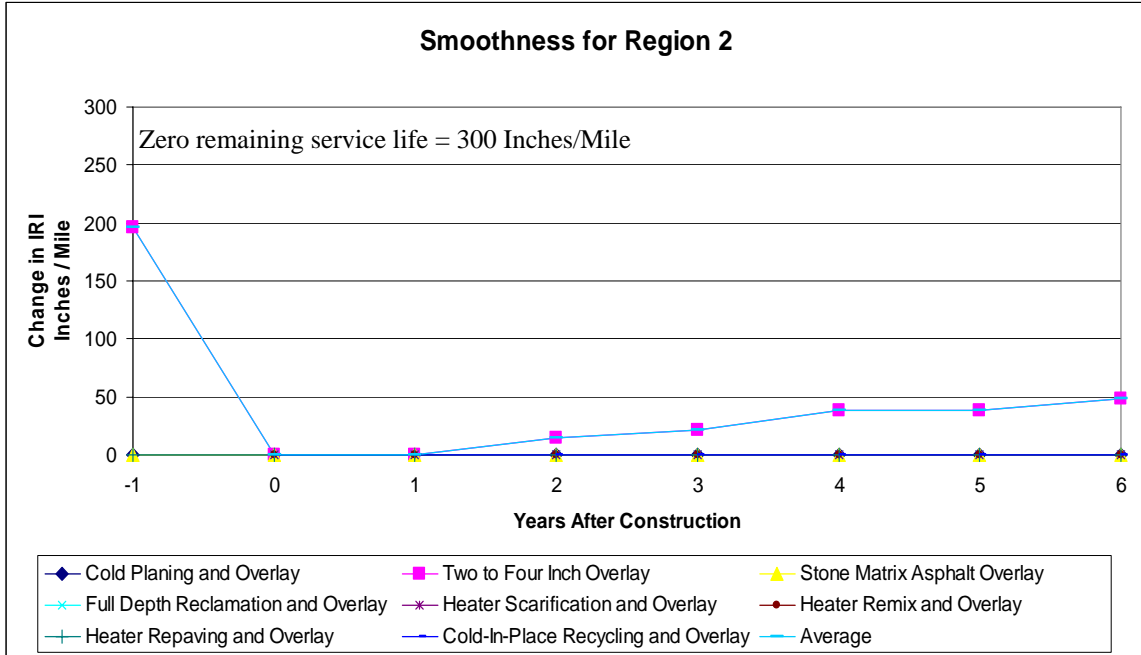


Figure 55 Rate of change for smoothness after six years in relation to Region 2

Table 59 Smoothness Performance – Region 2 Data

| Treatment | Region 2 | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|-------|-------|-------|-------|-------|---------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 196 | 0 | - | 14.11 | 21.29 | 38.62 | 38.62 | 48.90 | 8.87398 | 0.828 | 5.43 | ---- | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 196 | 0 | 0.00 | 14.11 | 21.29 | 38.62 | 38.62 | 48.90 | 8.87398 | 0.828 | 5.43 | ---- | |

Smoothness – Region 2

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

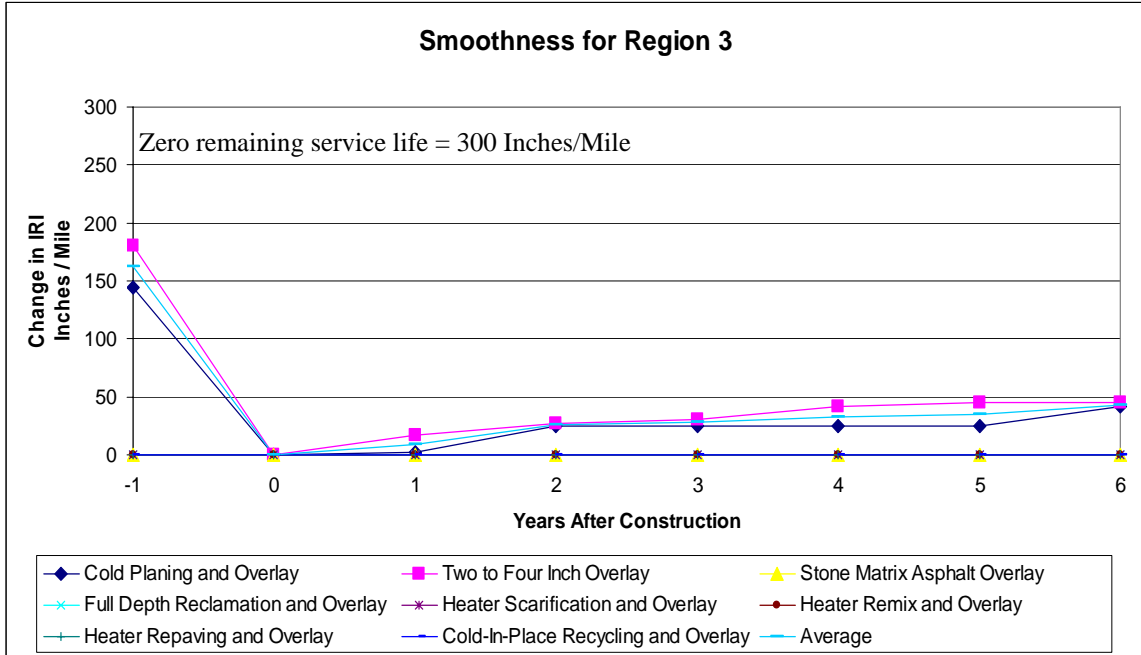


Figure 56 Rate of change for smoothness after six years in relation to Region 3

Table 60 Smoothness Performance – Region 3 Data

| Treatment | Region 3 | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|-------|-------|-------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 143.8667 | 0 | 1.93 | 24.67 | 24.67 | 24.67 | 24.67 | 41.40 | 6.059524 | 0.834 | 3 | |
| Two to Four Inch Overlay | 180.175 | 0 | 16.37 | 26.99 | 30.69 | 41.52 | 44.98 | 44.98 | 7.382273 | 0.844 | 6.71 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 162 | 0 | 9.15 | 25.83 | 27.68 | 33.09 | 34.83 | 43.19 | 6.720899 | | | |

Smoothness – Region 3

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. The cold planing and overlay and the 2 to 4-inch overlay are the only two rehabilitation strategies represented and they performed similarly as shown in Table 60.

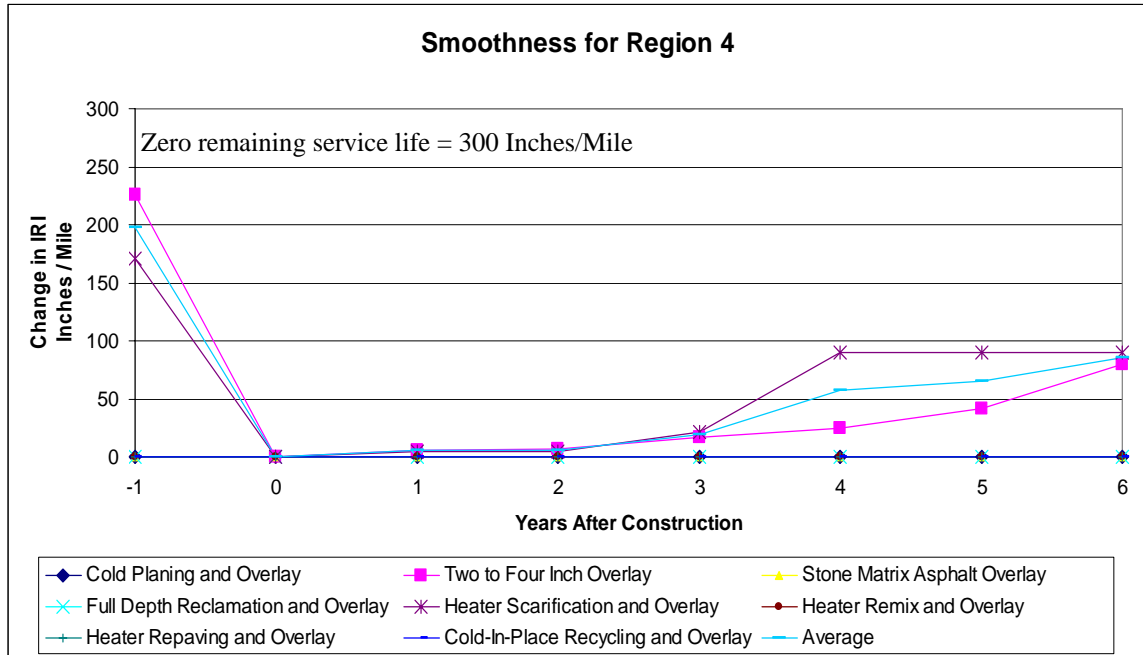


Figure 57 Rate of change for smoothness after six years in relation to Region 4

Table 61 Smoothness Performance – Region 4 Data

| Treatment | Region 4 | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|-------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 225.3 | 0 | 5.37 | 6.88 | 16.80 | 25.16 | 41.04 | 79.88 | 11.75952 | 0.792 | 4.57 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 170.5333 | 0 | 5.03 | 5.03 | 21.33 | 89.95 | 89.95 | 89.95 | 18.73571 | 0.868 | 3 | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 198 | 0 | 5.20 | 5.95 | 19.07 | 57.55 | 65.49 | 84.91 | 15.24762 | | | |

Smoothness – Region 4

Cold planing and overlay, stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch overlay showed the best performance when compared with other rehabilitation strategies. Heater scarification and overlay performed the worst as shown in Table 61.

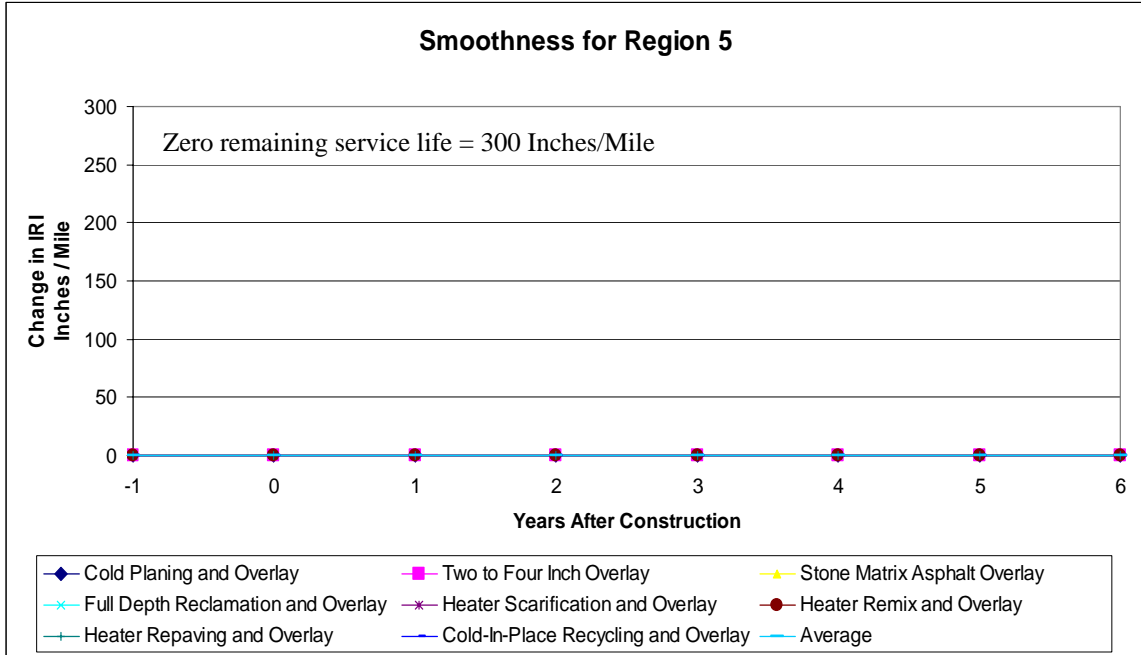


Figure 58 Rate of change for smoothness after six years in relation to Region 5

Table 62 Smoothness Performance – Region 5 Data

| Treatment | Region 5 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|---------|---------|---------|---------|---------|---------|---------|---------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | |

Smoothness – Region 5

None of the rehabilitation strategies met the predetermined criteria so an analysis could not be performed.

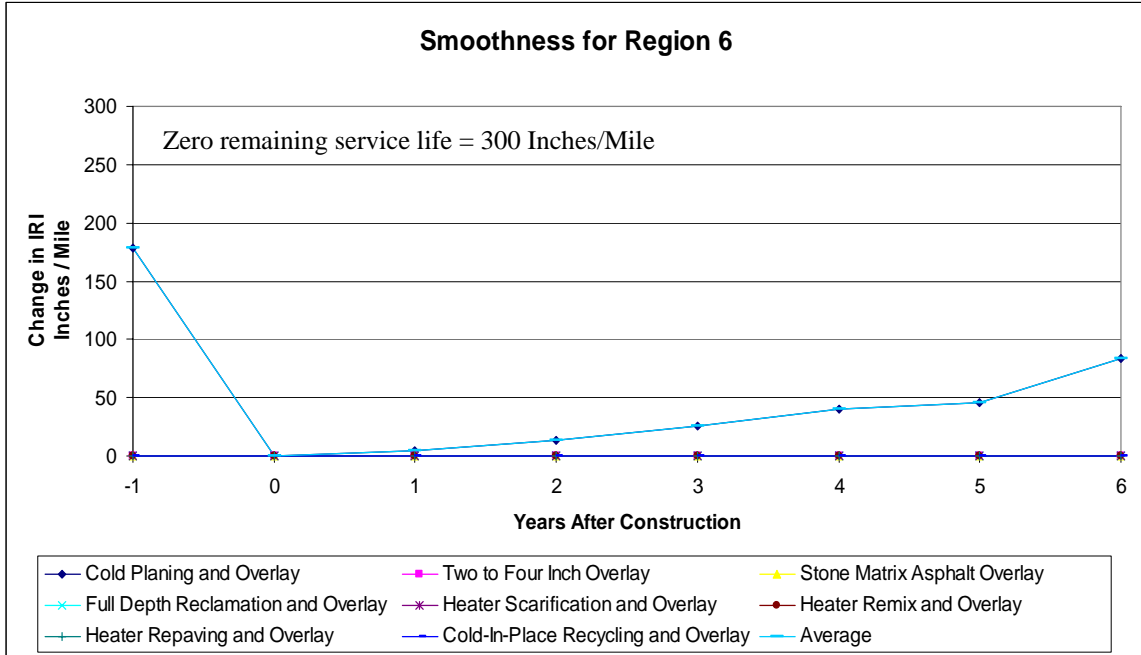


Figure 59 Rate of change for smoothness after six years in relation to Region 6

Table 63 Smoothness Performance – Region 6 Data

| Treatment | Region 6 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|-------|-------|-------|-------|-------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 178.9636 | 0 | 4.02 | 13.60 | 25.09 | 40.49 | 45.72 | 83.89 | 12.92744 | 0.839 | 7.29 |
| Two to Four Inch Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 179 | 0 | 4.02 | 13.60 | 25.09 | 40.49 | 45.72 | 83.89 | 12.92744 | | |

Smoothness – Region 6

Cold planing and overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

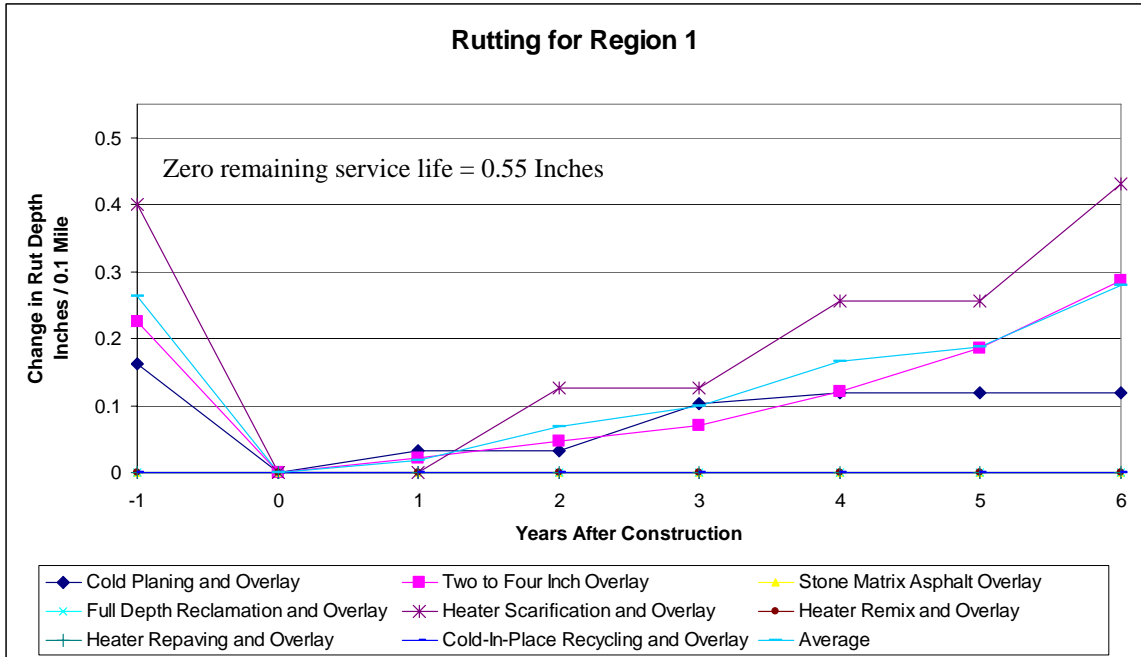


Figure 60 Permanent deformation performance after six years in relation to Region 1

Table 64 Rutting Performance – Region 1 Data

| Treatment | Region 1 | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|----------|---------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 0.163 | 0.00 | 0.03 | 0.03 | 0.10 | 0.12 | 0.12 | 0.12 | 0.12 | 0.02206 | 0.771 | 5.57 |
| Two to Four Inch Overlay | 0.2256 | 0 | 0.02 | 0.05 | 0.07 | 0.12 | 0.19 | 0.29 | 0.045076 | 0.914 | 7.57 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 0.4012 | 0 | - | 0.13 | 0.13 | 0.26 | 0.26 | 0.43 | 0.069187 | 0.871 | 6.43 | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 0 | 0 | 0.02 | 0.07 | 0.10 | 0.17 | 0.19 | 0.28 | 0.045441 | | | |

Rutting – Region 1

Stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of rutting per year. Heater scarification and overlay showed significantly more rutting per year than the other rehabilitation strategies as shown in Table 64.

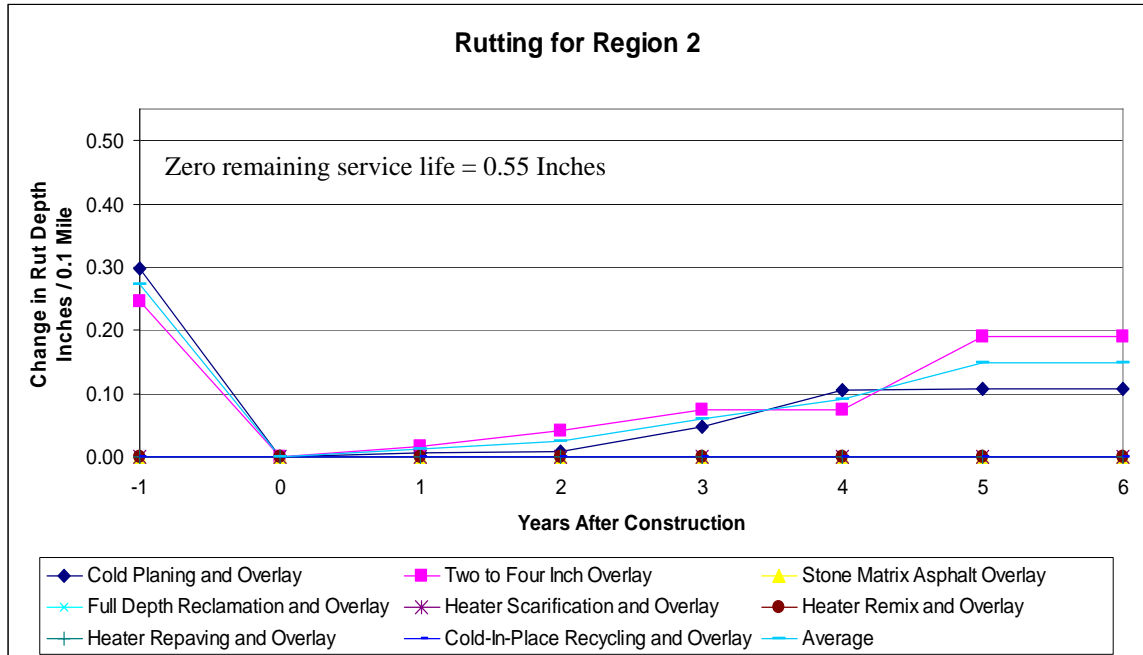


Figure 61 Permanent deformation performance after six years in relation to Region 2

Table 65 Rutting Performance – Region 2 Data

| Treatment | Region 2 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 0.298 | 0 | 0.01 | 0.01 | 0.05 | 0.11 | 0.11 | 0.11 | 0.022299 | 0.869 | 4.14 |
| Two to Four Inch Overlay | 0.246 | 0 | 0.02 | 0.04 | 0.07 | 0.07 | 0.19 | 0.19 | 0.033968 | 0.852 | 6.43 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 0 | 0 | 0.01 | 0.02 | 0.06 | 0.09 | 0.15 | 0.15 | 0.028133 | | |

Rutting – Region 2

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Both cold planing and overlay and 2 to 4-inch overlay performed similarly and are the only two rehabilitation strategies that met the predetermined criteria so an analysis could not be completed as shown in Table 65.

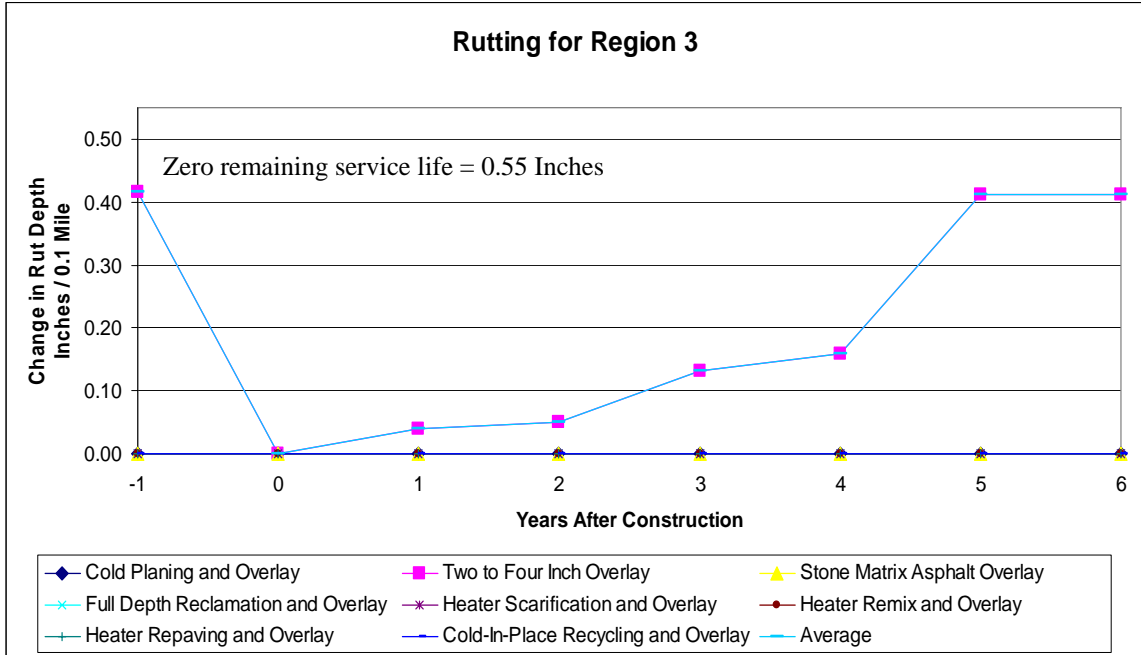


Figure 62 Permanent deformation performance after six years in relation to Region 3

Table 66 Rutting Performance – Region 3 Data

| Treatment | Region 3 | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|--------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 0.4154 | 0 | 0.04 | 0.05 | 0.13 | 0.16 | 0.41 | 0.41 | 0.0746 | 0.611 | 11.43 | | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Average | 0 | 0 | 0.04 | 0.05 | 0.13 | 0.16 | 0.41 | 0.41 | 0.0746 | | | | |

Rutting – Region 3

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

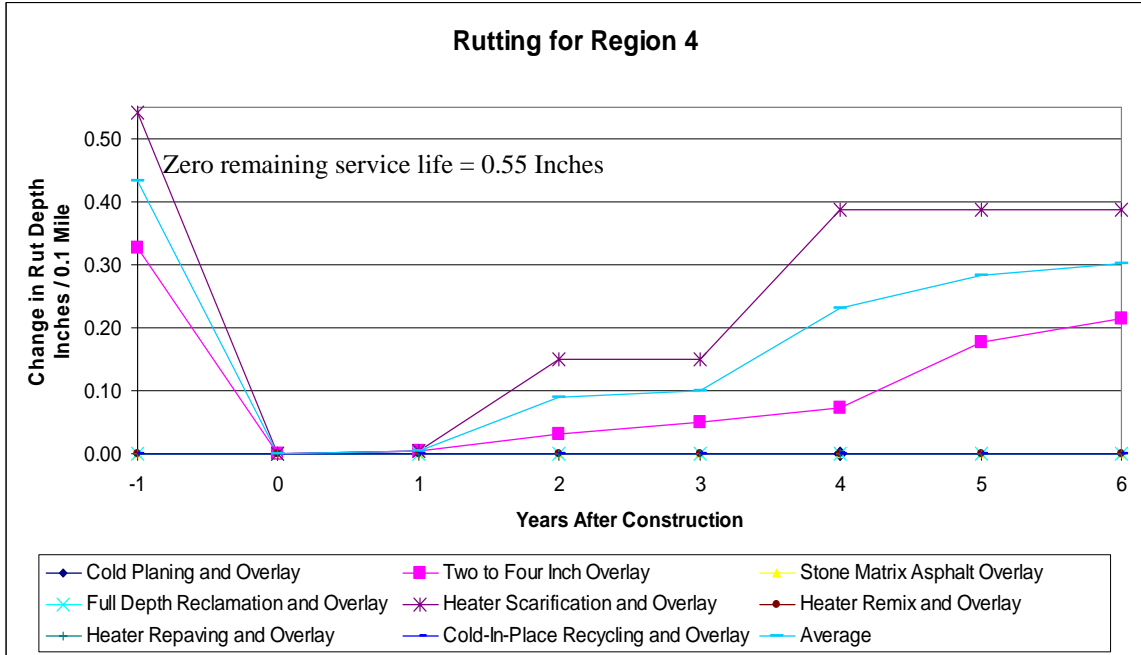


Figure 63 Permanent deformation performance after six years in relation to Region 4

Table 67 Rutting Performance – Region 4 Data

| Treatment | Region 4 | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 0.3265 | 0 | 0.00 | 0.03 | 0.05 | 0.07 | 0.18 | 0.21 | 0.036879 | 0.834 | 8.57 | | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Scarification and Overlay | 0.542 | 0 | 0.00 | 0.15 | 0.15 | 0.39 | 0.39 | 0.39 | 0.077586 | 0.859 | 3 | | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | | |
| Average | 0 | 0 | 0.00 | 0.09 | 0.10 | 0.23 | 0.28 | 0.30 | 0.057232 | | | | |

Rutting – Region 4

Cold planing and overlay, stone matrix asphalt overlay, full depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. 2 to 4 inch overlay showed significantly less amounts of rutting per year than heater scarification and overlay as shown in Table 67.

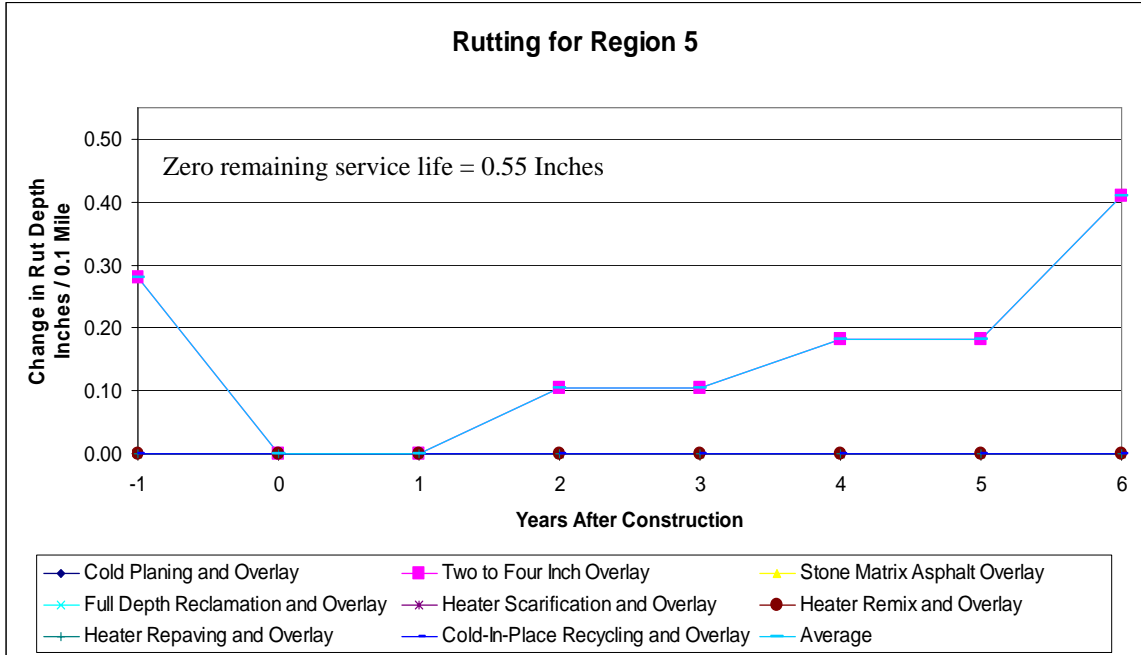


Figure 64 Permanent deformation performance after six years in relation to Region 5

Table 68 Rutting Performance – Region 5 Data

| Treatment | Region 5 | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|-------|----------------|------------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 0.28 | 0 | - | 0.10 | 0.10 | 0.18 | 0.18 | 0.41 | 0.059667 | 0.896 3.29 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 0 | 0 | 0.00 | 0.10 | 0.10 | 0.18 | 0.18 | 0.41 | 0.059667 | |

Rutting – Region 5

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

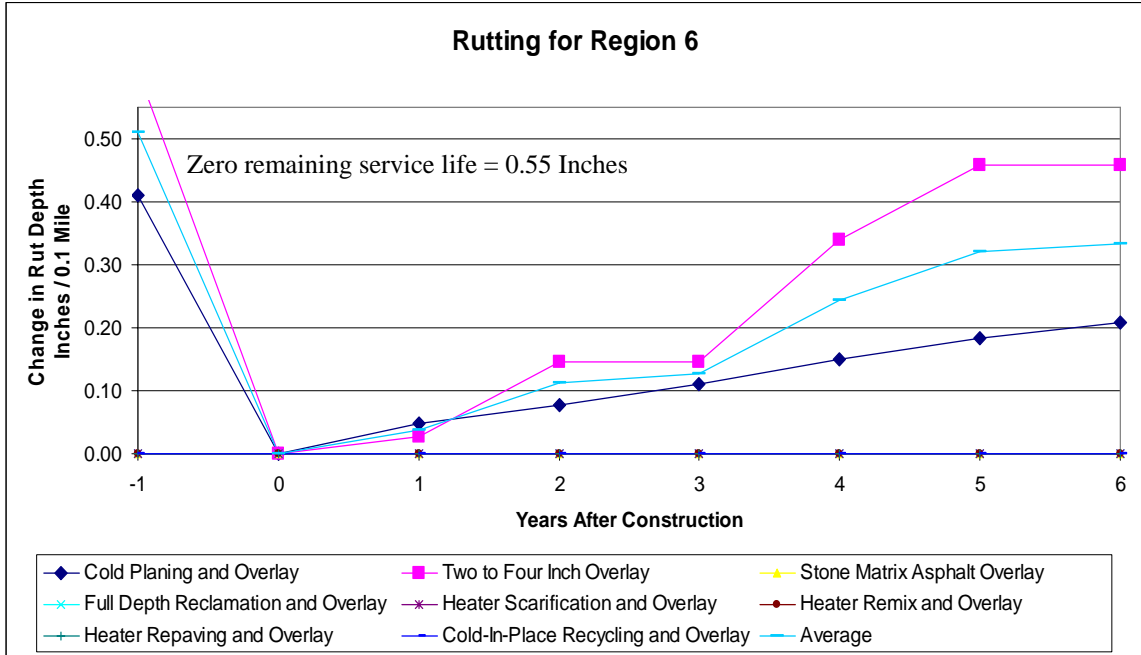


Figure 65 Permanent deformation performance after six years in relation to Region 6

Table 69 Rutting Performance – Region 6 Data

| Treatment | Region 6 | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|------|------|------|------|------|------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 0.4108 | 0 | 0.05 | 0.08 | 0.11 | 0.15 | 0.18 | 0.21 | 0.034709 | 0.869 | 15 | |
| Two to Four Inch Overlay | 0.608667 | 0 | 0.03 | 0.15 | 0.15 | 0.34 | 0.46 | 0.46 | 0.086786 | 0.864 | 5.57 | |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Average | 1 | 0 | 0.04 | 0.11 | 0.13 | 0.24 | 0.32 | 0.33 | 0.060748 | | | |

Rutting – Region 6

Stone matrix asphalt overlay, full depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed a significantly less amount of rutting per year than 2 to 4 inch overlay as shown in Table 69.

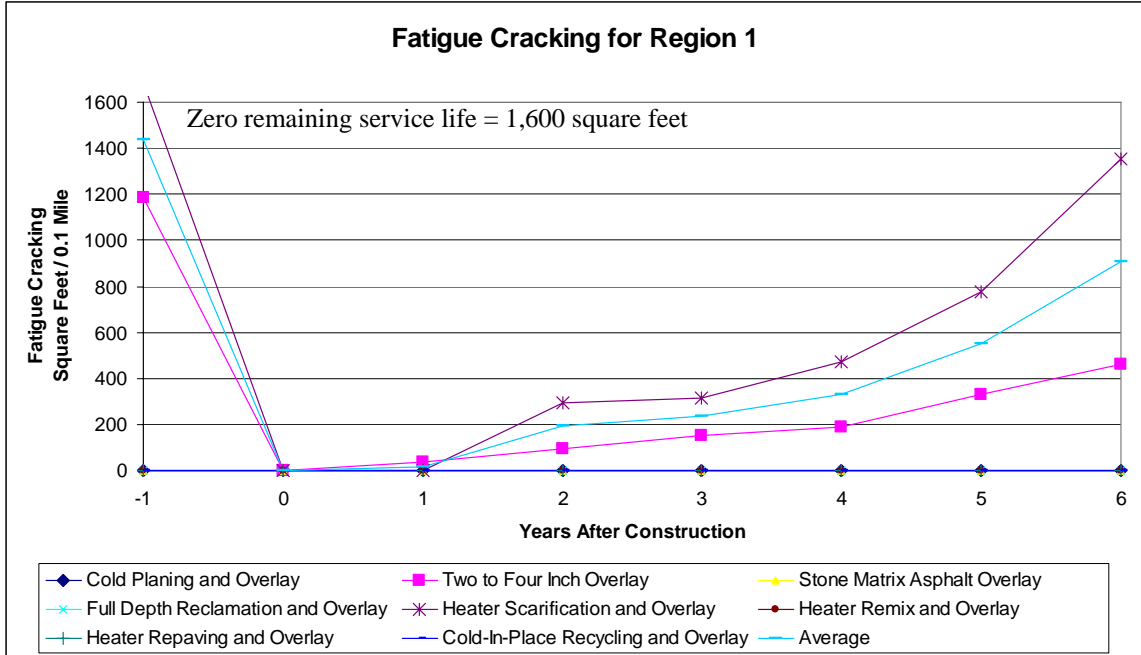


Figure 66 Fatigue cracking performance after six years in relation to Region 1

Table 70 Fatigue Performance – Region 1 Data

| Treatment | Region 1 | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|-------|--------|--------|--------|--------|----------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Two to Four Inch Overlay | 1185.218 | 0 | 35.66 | 95.53 | 153.53 | 190.49 | 328.43 | 460.18 | 73.60826 | 0.483 | 9.29 | | |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |
| Heater Scarification and Overlay | 1684.743 | 0 | - | 296.17 | 316.17 | 471.04 | 777.59 | 1,351.04 | 206.542 | 0.673 | 8.14 | | |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |
| Average | 1435 | 0 | 17.83 | 195.85 | 234.85 | 330.76 | 553.01 | 905.61 | 140.0751 | | | | |

Fatigue – Region 1

Cold planing and overlay, stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed significantly less amounts of fatigue cracking than heater scarification and overlay as shown in Table 70.

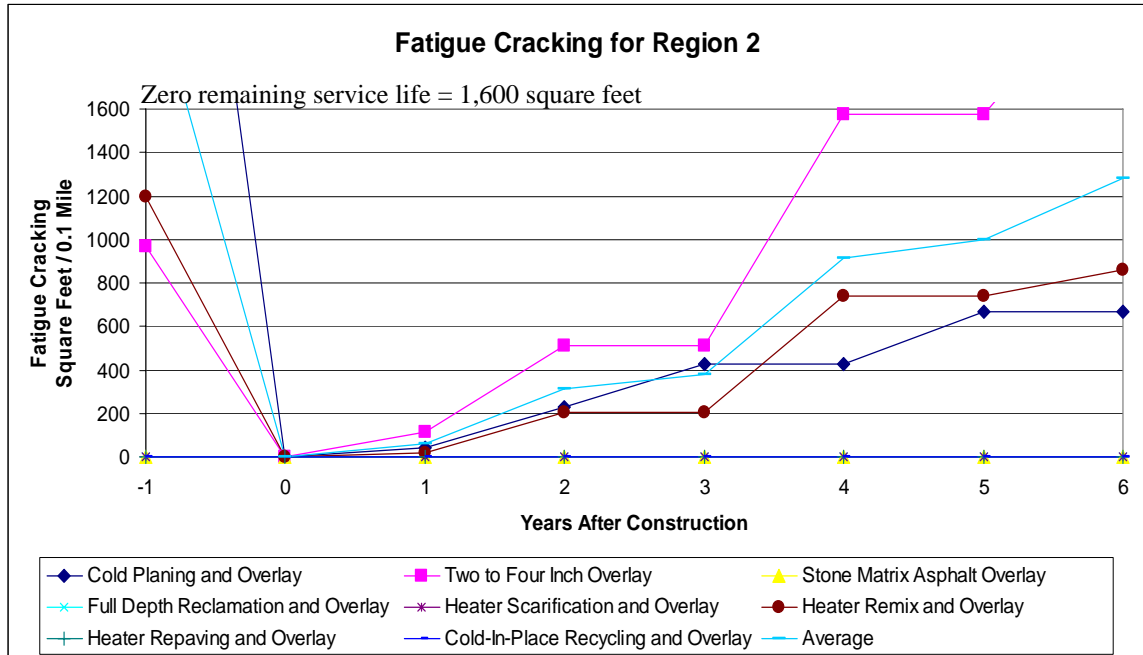


Figure 67 Fatigue cracking performance after six years in relation to Region 2

Table 71 Fatigue Performance – Region 2 Data

| Treatment | Region 2 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|--------|--------|--------|----------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 4710.333 | 0 | 39.74 | 226.97 | 426.77 | 430.06 | 669.89 | 669.89 | 124.0378 | 0.549 | 6.43 |
| Two to Four Inch Overlay | 966.65 | 0 | 114.94 | 512.77 | 512.77 | 1,578.44 | 1,578.44 | 2,322.24 | 391.4078 | 0.395 | 4.86 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | 1199.2 | 0 | 19.13 | 204.53 | 204.53 | 741.87 | 741.87 | 857.97 | 162.7393 | 0.76 | 2.71 |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 2292 | 0 | 57.94 | 314.76 | 381.36 | 916.79 | 996.73 | 1283.37 | 226.0616 | | |

Fatigue – Region 2

Stone matrix asphalt and overlay, full depth reclamation and overlay, heater scarification and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of fatigue cracking per year. Two to 4-inch overlay showed significantly more fatigue cracking per year than the other rehabilitation strategies as shown in Table 71.

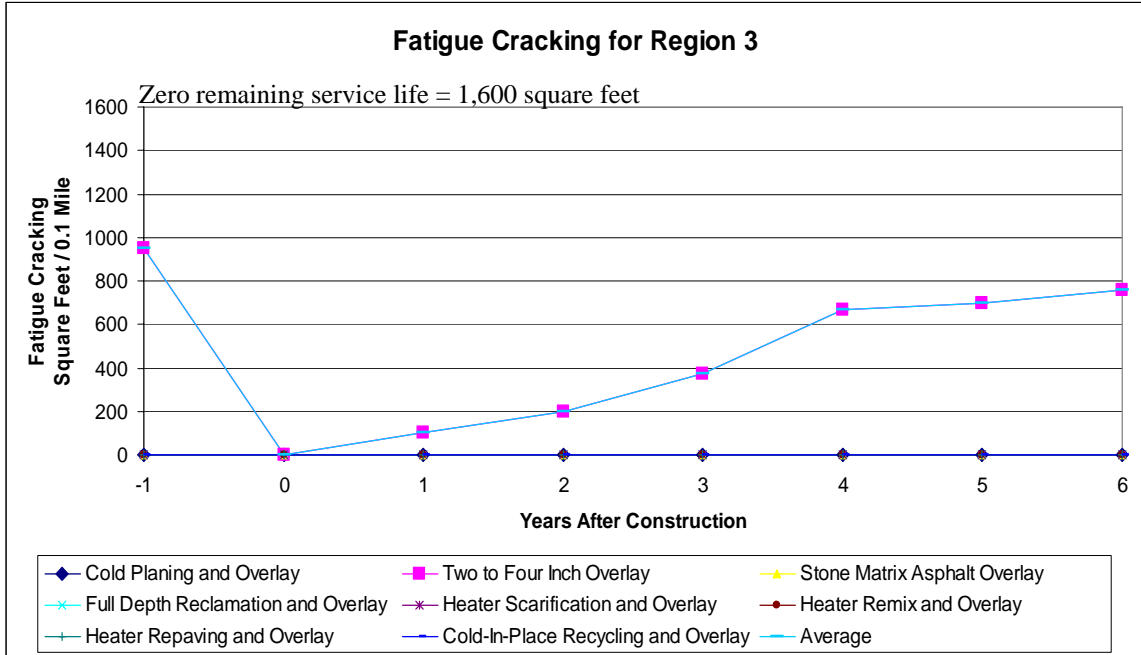


Figure 68 Fatigue cracking performance after six years in relation to Region 3

Table 72 Fatigue Performance – Region 3 Data

| Treatment | Region 3 | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|--------|--------|--------|--------|--------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | |
| Two to Four Inch Overlay | 948.3857 | 0 | 102.63 | 198.60 | 370.35 | 669.93 | 698.85 | 756.61 | |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | |
| Average | 948 | 0 | 102.63 | 198.60 | 370.35 | 669.93 | 698.85 | 756.61 | |

Fatigue – Region 3

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

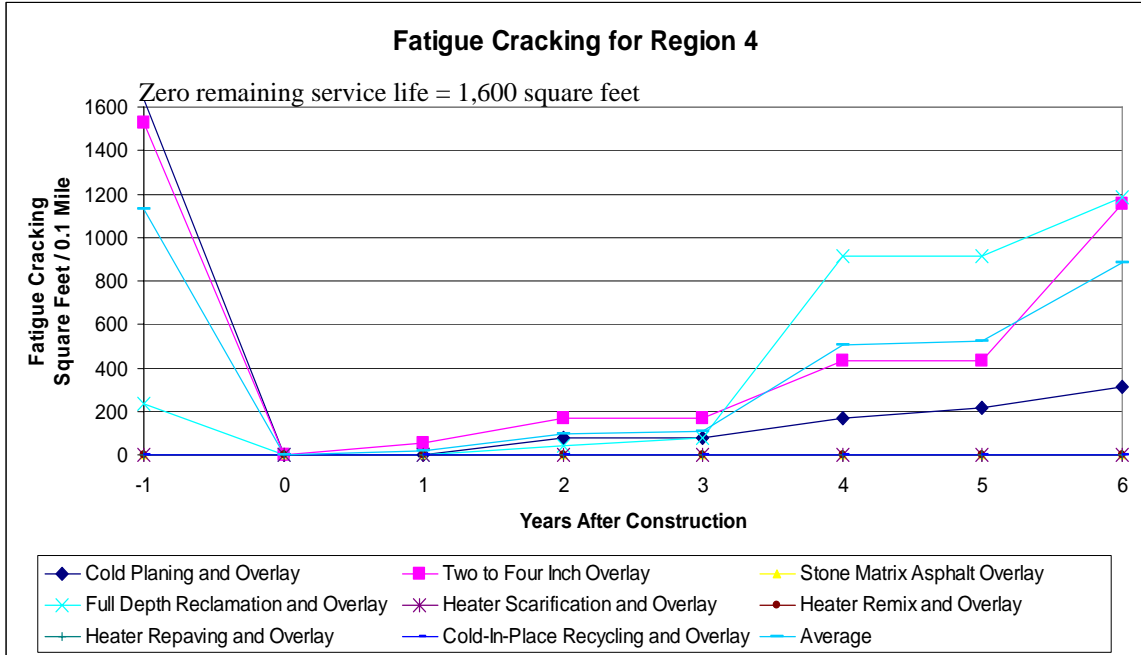


Figure 69 Fatigue cracking performance after six years in relation to Region 4

Table 73 Fatigue Performance – Region 4 Data

| Treatment | Region 4 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|-------|--------|--------|--------|--------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 1638.8 | 0 | - | 79.37 | 79.37 | 168.82 | 214.92 | 312.42 | 52.01905 | 0.629 | 2.86 |
| Two to Four Inch Overlay | 1527.44 | 0 | 52.02 | 169.20 | 169.20 | 434.18 | 434.18 | 1,153.69 | 160.3699 | 0.296 | 10.86 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | 234.8 | 0 | - | 41.36 | 80.04 | 917.24 | 917.24 | 1,184.77 | 223.7386 | 0.202 | 4 |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 1134 | 0 | 17.34 | 96.64 | 109.54 | 506.75 | 522.11 | 883.63 | 145.3758 | | |

Fatigue – Region 4

Stone matrix asphalt overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less fatigue cracking per year than the other rehabilitation strategies. Full depth reclamation and overlay showed the most amount of fatigue cracking per year as shown in Table 73.

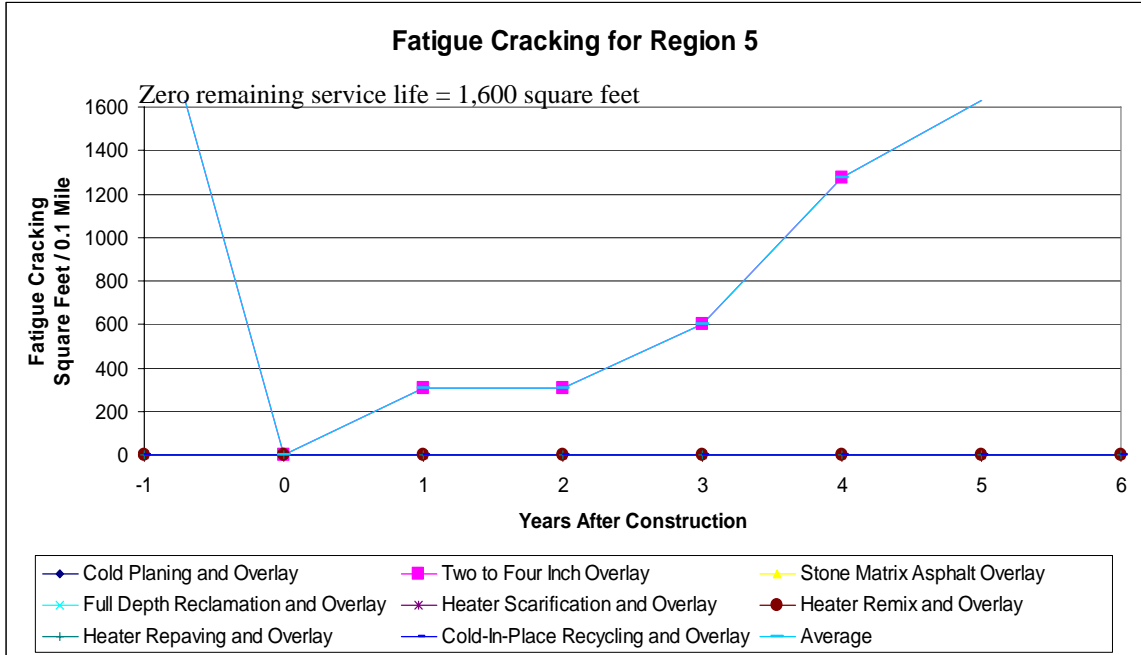


Figure 70 Fatigue cracking performance after six years in relation to Region 5

Table 74 Fatigue Performance – Region 5 Data

| Treatment | Region 5 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|--------|--------|--------|----------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Two to Four Inch Overlay | 2305.867 | 0 | 307.83 | 307.83 | 600.01 | 1,277.91 | 1,631.76 | 4,346.76 | 594.9371 | 0.549 | 3.29 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 2306 | 0 | 307.83 | 307.83 | 600.01 | 1277.91 | 1631.76 | 4346.76 | 594.9371 | | |

Fatigue – Region 5

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

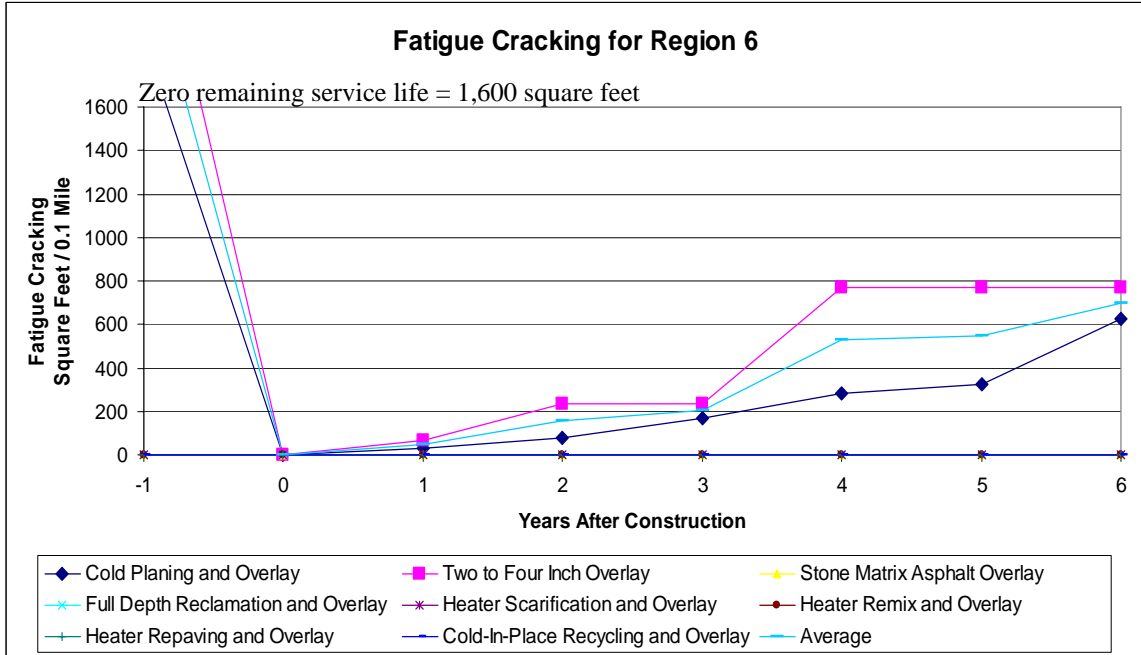


Figure 71 Fatigue cracking performance after six years in relation to Region 6

Table 75 Fatigue Performance – Region 6 Data

| Treatment | Region 6 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|-------|--------|--------|--------|--------|--------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 1917.2 | 0 | 31.15 | 75.61 | 169.16 | 284.90 | 325.66 | 626.73 | 95.66131 | 0.644 | 14.43 |
| Two to Four Inch Overlay | 2738.1 | 0 | 64.70 | 235.65 | 235.65 | 771.85 | 771.85 | 771.85 | 152.3589 | 0.597 | 2.86 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 2328 | 0 | 47.92 | 155.63 | 202.41 | 528.38 | 548.76 | 699.29 | 124.0101 | | |

Fatigue – Region 6

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed less fatigue cracking per year than 2 to 4 inch overlay as shown in Table 75.

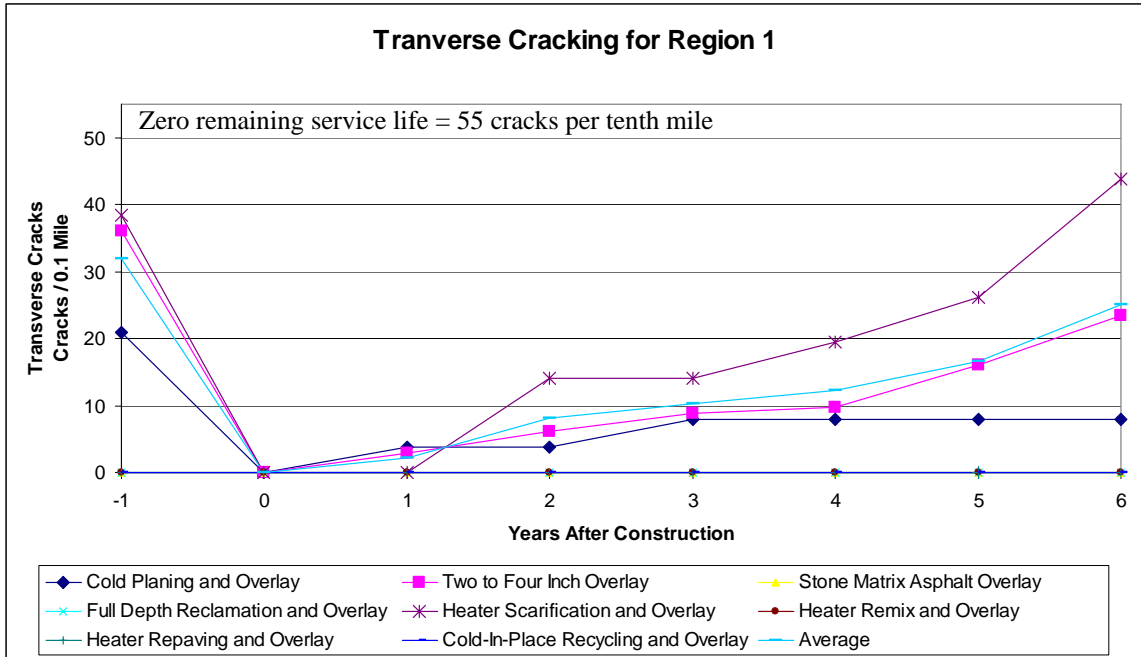


Figure 72 Transverse cracking performance after six years in relation to Region 1

Table 76 Transverse Cracking Performance – Region 1 Data

| Treatment | Region 1 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|-------|-------|-------|-------|-------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 21 | 0.00 | 3.80 | 3.80 | 7.90 | 7.90 | 7.90 | 7.90 | 1.285714 | 0.661 | 3 |
| Two to Four Inch Overlay | 36.11111 | 0 | 2.81 | 6.20 | 8.84 | 9.66 | 15.96 | 23.36 | 3.566039 | 0.809 | 9.14 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 38.4 | 0 | - | 14.10 | 14.10 | 19.46 | 26.06 | 43.73 | 6.738393 | 0.717 | 9.57 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 32 | 0 | 2.20 | 8.03 | 10.28 | 12.34 | 16.64 | 25.00 | 3.863382 | | |

Transverse Cracking – Region 1

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Heater scarification and overlay showed significantly more transverse cracking than any other rehabilitation strategy as shown in Table 76.

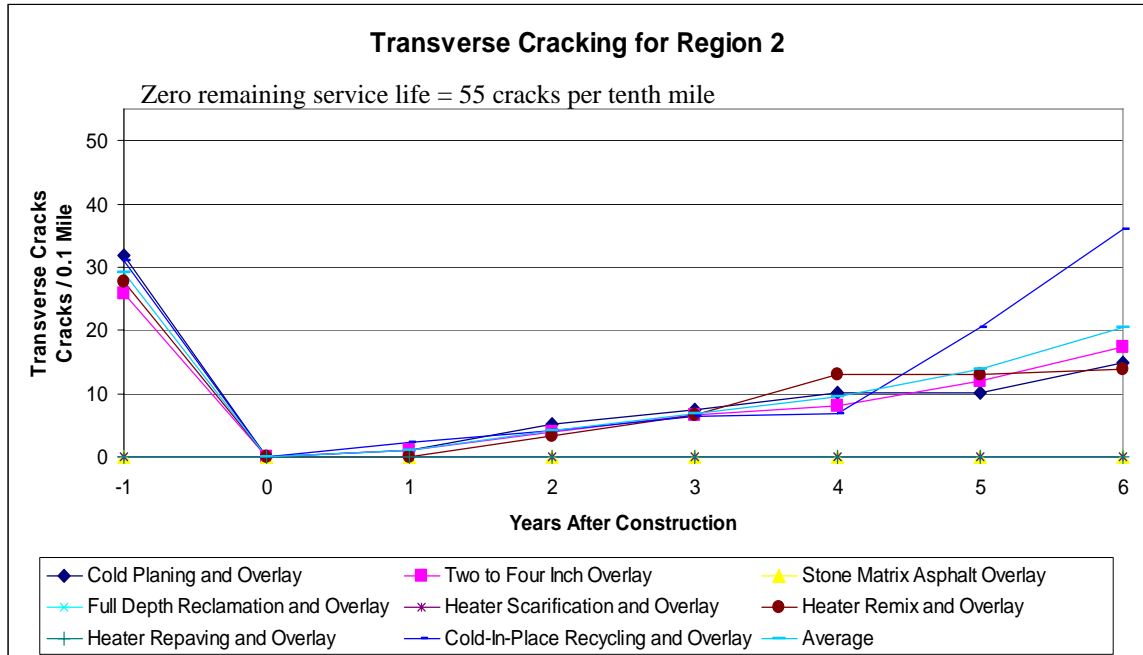


Figure 73 Transverse cracking performance after six years in relation to Region 2

Table 77 Transverse Cracking Performance – Region 2 Data

| Treatment | Region 2 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|------|------|------|-------|-------|-------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 31.92 | 0 | 0.96 | 5.21 | 7.47 | 10.13 | 10.13 | 14.81 | 2.417985 | 0.692 | 8.14 |
| Two to Four Inch Overlay | 25.77 | 0 | 1.07 | 3.88 | 6.67 | 8.03 | 12.09 | 17.30 | 2.789371 | 0.797 | 10.14 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | 27.7 | 0 | - | 3.40 | 6.65 | 13.00 | 13.00 | 13.90 | 2.760714 | 0.908 | 3.43 |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | 31 | 0 | 2.20 | 4.20 | 6.33 | 8.80 | 20.53 | 36.07 | 5.266667 | 0.629 | 3 |
| Average | 29 | 0 | 1.06 | 4.17 | 6.78 | 9.49 | 13.94 | 20.52 | 3.308684 | | |

Transverse Cracking – Region 2

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, and heater repaving and overlay are not represented. Cold planing and overlay, 2 to 4 inch overlay, and heater remix and overlay all showed close to the same amount of transverse cracking per year. Cold-in-place recycling and overlay showed around twice as much transverse cracking per year than the other rehabilitation strategies as shown in Table 77.

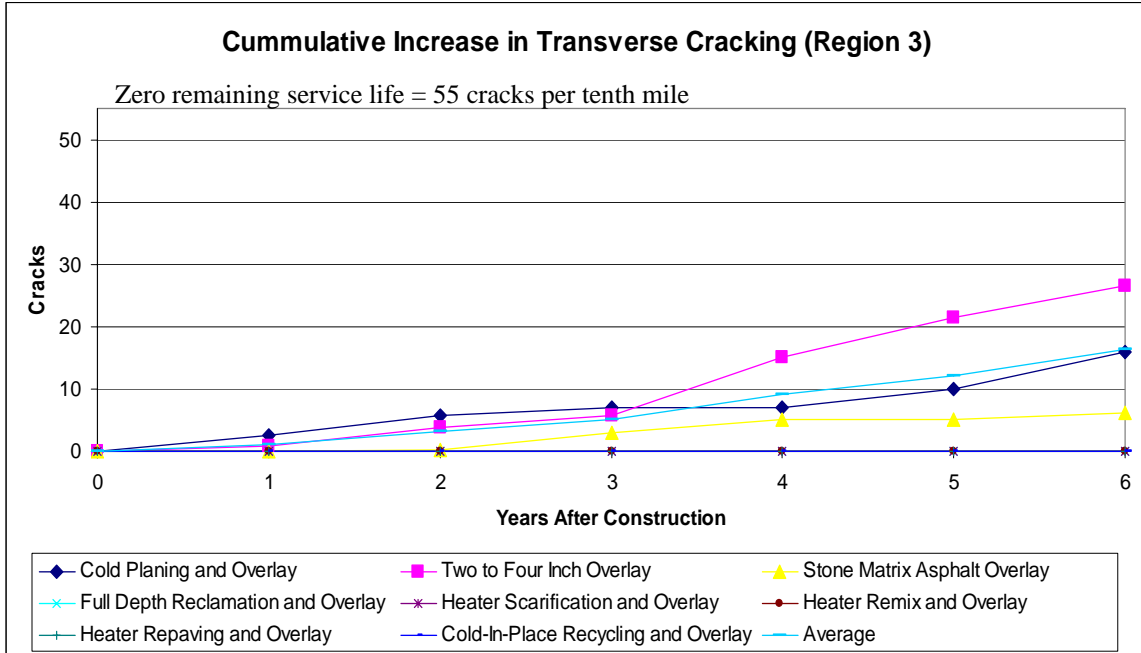


Figure 74 Transverse cracking performance after six years in relation to Region 3

Table 78 Transverse Cracking Performance – Region 3 Data

| Treatment | Region 3 | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 12.45 | 0 | 2.50 | 5.80 | 6.95 | 6.95 | 9.90 | 16.00 | 2.283929 | 0.841 | 3.43 | |
| Two to Four Inch Overlay | 40.90588 | 0 | 0.94 | 3.78 | 5.74 | 14.97 | 21.51 | 26.56 | 4.715153 | 0.724 | 17.86 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 27 | 0 | 1.72 | 4.79 | 6.34 | 10.96 | 15.71 | 21.28 | 3.499541 | | | |

Transverse Cracking – Region 3

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Two to 4-inch overlay showed the most transverse cracking per year as shown in Table 78.

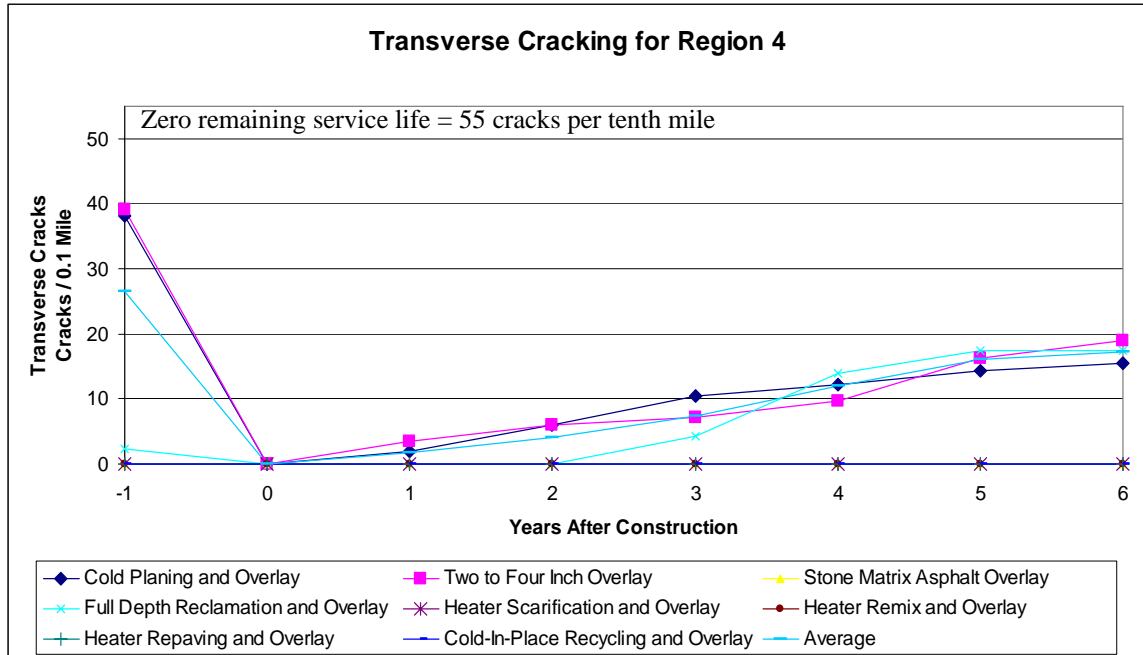


Figure 75 Transverse cracking performance after six years in relation to Region 4

Table 79 Transverse Cracking Performance – Region 4 Data

| Treatment | Region 4 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|------|------|-------|-------|-------|-------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 38.15 | 0 | 1.95 | 6.08 | 10.48 | 12.28 | 14.40 | 15.56 | 2.778095 | 0.709 | 5.71 |
| Two to Four Inch Overlay | 39.06667 | 0 | 3.43 | 6.10 | 7.25 | 9.61 | 16.33 | 18.92 | 3.074329 | 0.748 | 10.71 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | 2.4 | 0 | - | 0.10 | 4.35 | 13.99 | 17.50 | 17.50 | 3.62034 | 0.687 | 4.86 |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 27 | 0 | 1.79 | 4.09 | 7.36 | 11.96 | 16.08 | 17.33 | 3.157588 | | |

Transverse Cracking – Region 4

Stone matrix asphalt overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Both cold planing and overlay, and 2 to 4 inch overlay performed similarly. Full depth reclamation and overlay showed a greater amount of transverse cracking than the other two rehabilitation strategies as shown in Table 79.

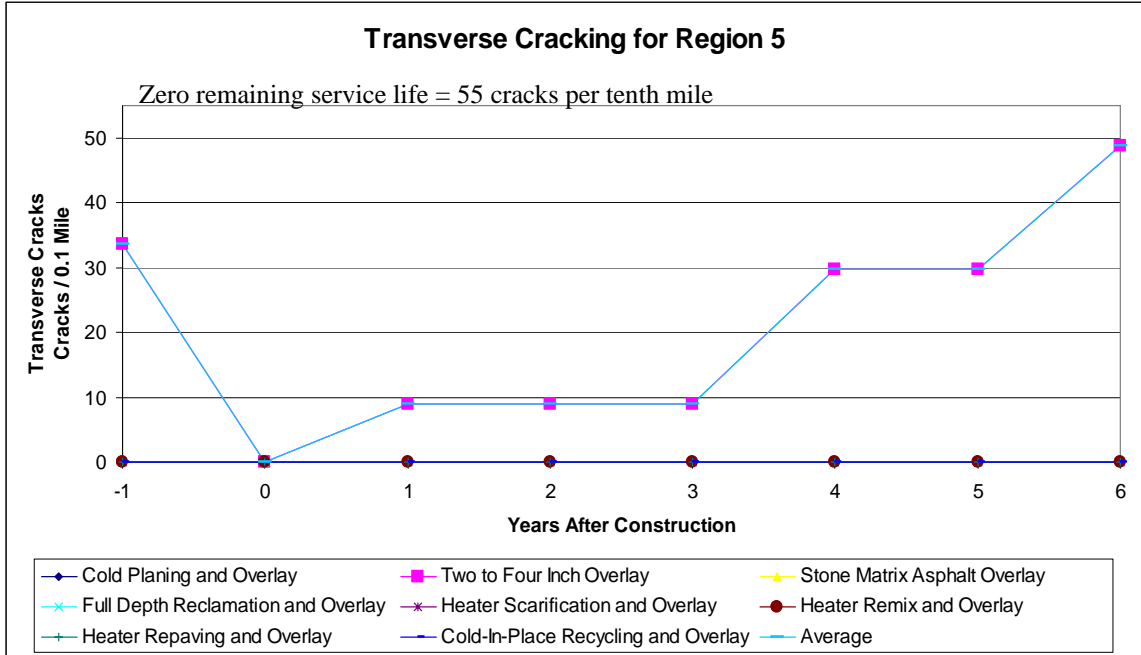


Figure 76 Transverse cracking performance after six years in relation to Region 5

Table 80 Transverse Cracking Performance – Region 5 Data

| Treatment | Region 5 | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|-------|-------|-------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 33.56 | 0 | 8.88 | 9.00 | 9.00 | 29.70 | 29.70 | 48.83 | 7.458571 | 0.613 | 3.86 | | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 34 | 0 | 8.88 | 9.00 | 9.00 | 29.70 | 29.70 | 48.83 | 7.458571 | | | | |

Transverse Cracking – Region 5

2 to 4 inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

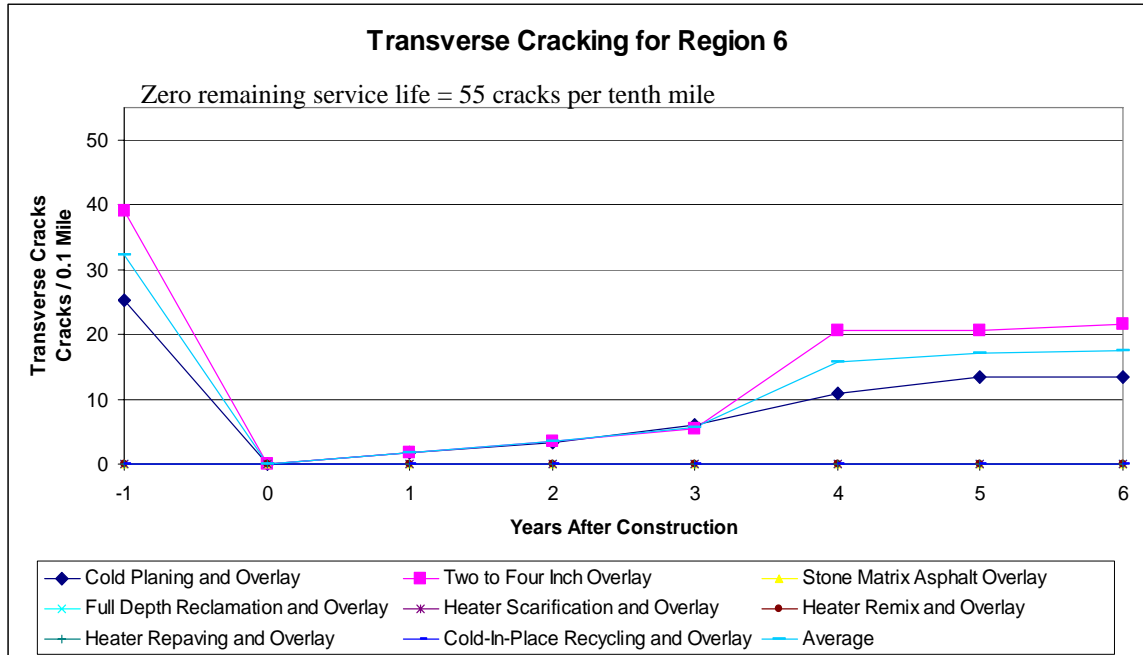


Figure 77 Transverse cracking performance after six years in relation to Region 6

Table 81 Transverse Cracking Performance – Region 6 Data

| Treatment | Region 6 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|-------|-------|-------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 25.31429 | 0 | 1.70 | 3.31 | 5.93 | 10.84 | 13.39 | 13.39 | 2.538845 | 0.731 | 19.14 |
| Two to Four Inch Overlay | 39.16 | 0 | 1.70 | 3.50 | 5.47 | 20.63 | 20.63 | 21.53 | 4.271429 | 0.618 | 4.86 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 32 | 0 | 1.70 | 3.41 | 5.70 | 15.73 | 17.01 | 17.46 | 3.405137 | | |

Transverse Cracking – Region 6

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Two to 4-inch overlay showed the greatest amount of transverse cracking per year as shown in Table 81.

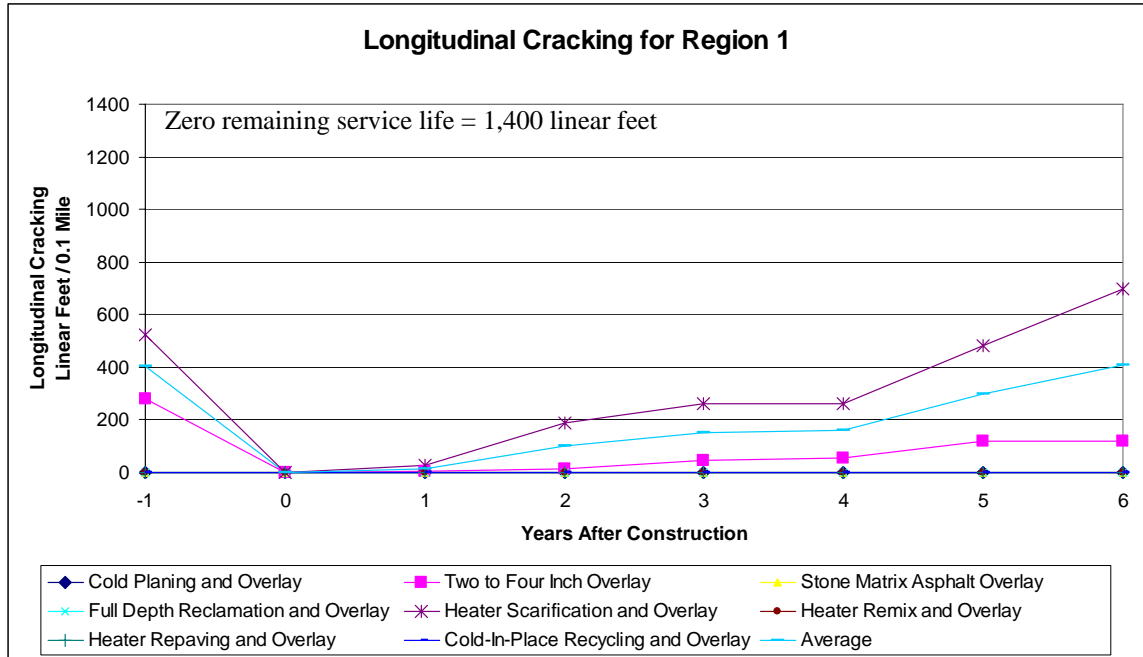


Figure 78 Longitudinal cracking performance after six years in relation to Region 1

Table 82 Longitudinal Cracking Performance – Region 1 Data

| Treatment | Region 1 | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|-----|-----|-----|-----|-----|-----|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Two to Four Inch Overlay | 280.0286 | 0 | 4 | 13 | 44 | 55 | 119 | 119 | 22.35149 | 0.613 | 6.57 | | |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Scarification and Overlay | 524.8 | 0 | 26 | 190 | 262 | 262 | 481 | 698 | 109.8685 | 0.701 | 8.57 | | |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Average | 402 | 0 | 15 | 101 | 153 | 158 | 300 | 408 | 66.11001 | | | | |

Longitudinal Cracking – Region 1

Cold planing and overlay, stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed significantly less longitudinal cracking per year compared to the other rehabilitation strategies. Heater scarification and overlay showed the greatest amount of longitudinal cracking per year as shown in Table 82.

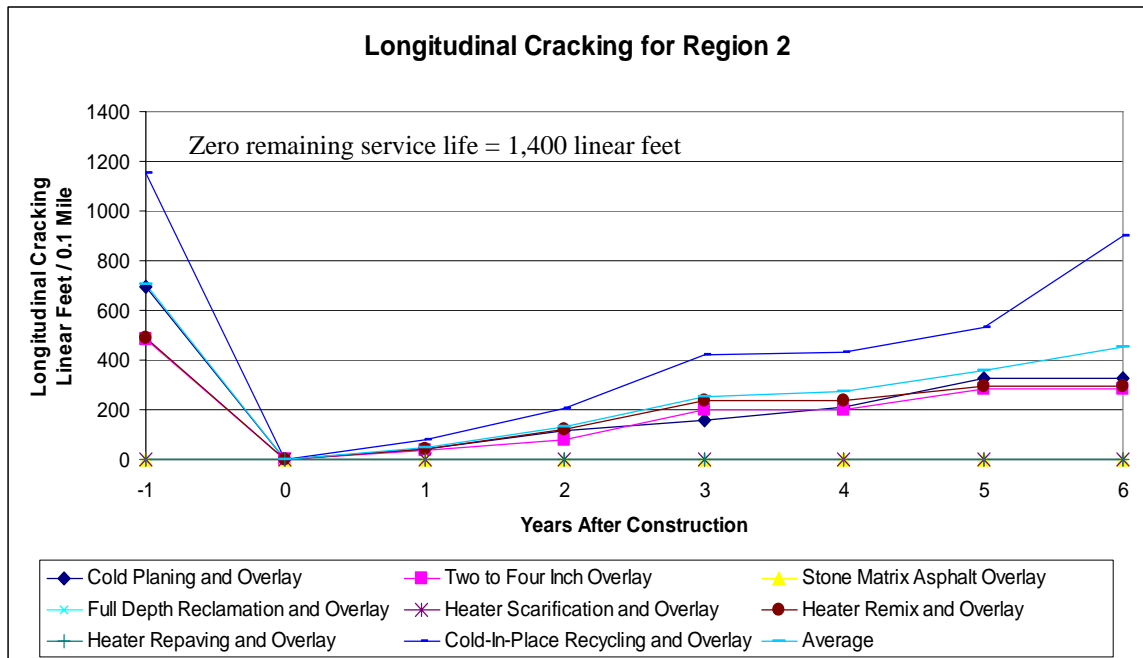


Figure 79 Longitudinal cracking performance after six years in relation to Region 2

Table 83 Longitudinal Cracking Performance – Region 2 Data

| Treatment | Region 2 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 697.1333 | 0 | 40 | 117 | 160 | 213 | 327 | 327 | 58.87236 | 0.734 | 6.71 |
| Two to Four Inch Overlay | 486.1429 | 0 | 39 | 77 | 200 | 200 | 286 | 286 | 52.66088 | 0.655 | 4.14 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | 488.2 | 0 | 42 | 123 | 239 | 239 | 293 | 293 | 53.48095 | 0.809 | 2.71 |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | 1151.1 | 0 | 79 | 208 | 422 | 433 | 534 | 903 | 137.269 | 0.711 | 3 |
| Average | 706 | 0 | 50 | 131 | 255 | 271 | 360 | 452 | 75.57081 | | |

Longitudinal Cracking – Region 2

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, and heater repaving and overlay are not represented. Cold planing and overlay and 2 to 4 inch overlay showed the least amounts of longitudinal cracking per year. Cold-in-place recycling and overlay showed significantly more longitudinal cracking per year as shown in Table 83.

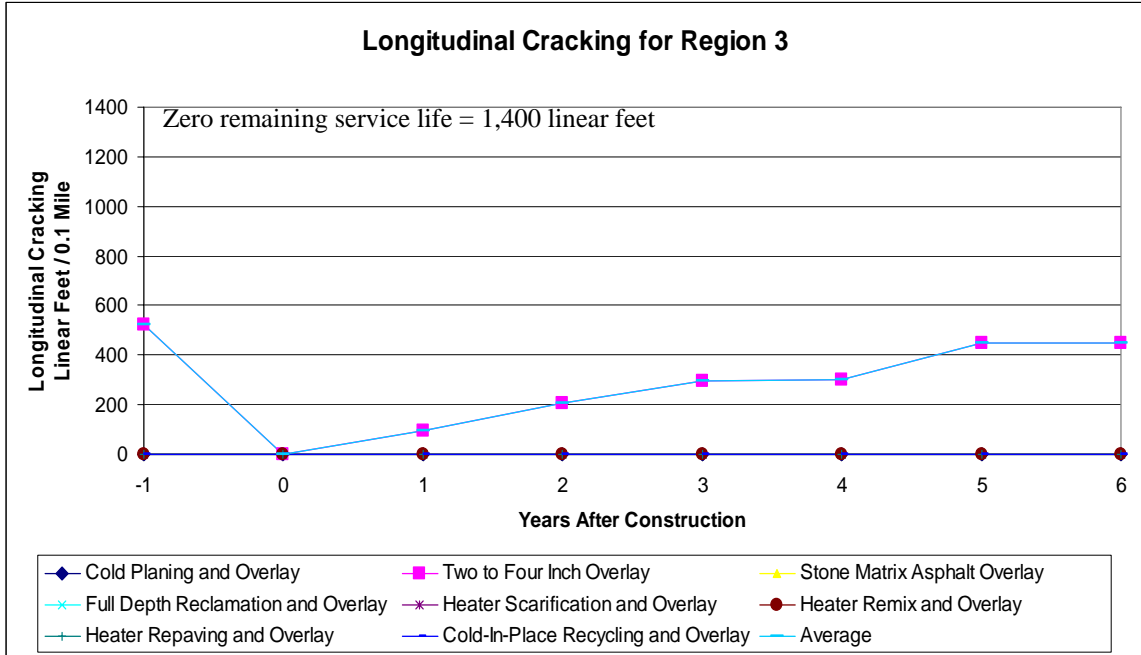


Figure 80 Longitudinal cracking performance after six years in relation to Region 3

Table 84 Longitudinal Cracking Performance – Region 3 Data

| Treatment | Region 3 | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|-----|-----|-----|-----|-----|-------|----------------|-------------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Two to Four Inch Overlay | 522.5286 | 0 | 94 | 208 | 295 | 302 | 451 | 451 | 77.12623 | 0.821 14.43 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 523 | 0 | 94 | 208 | 295 | 302 | 451 | 451 | 77.12623 | |

Longitudinal Cracking – Region 3

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

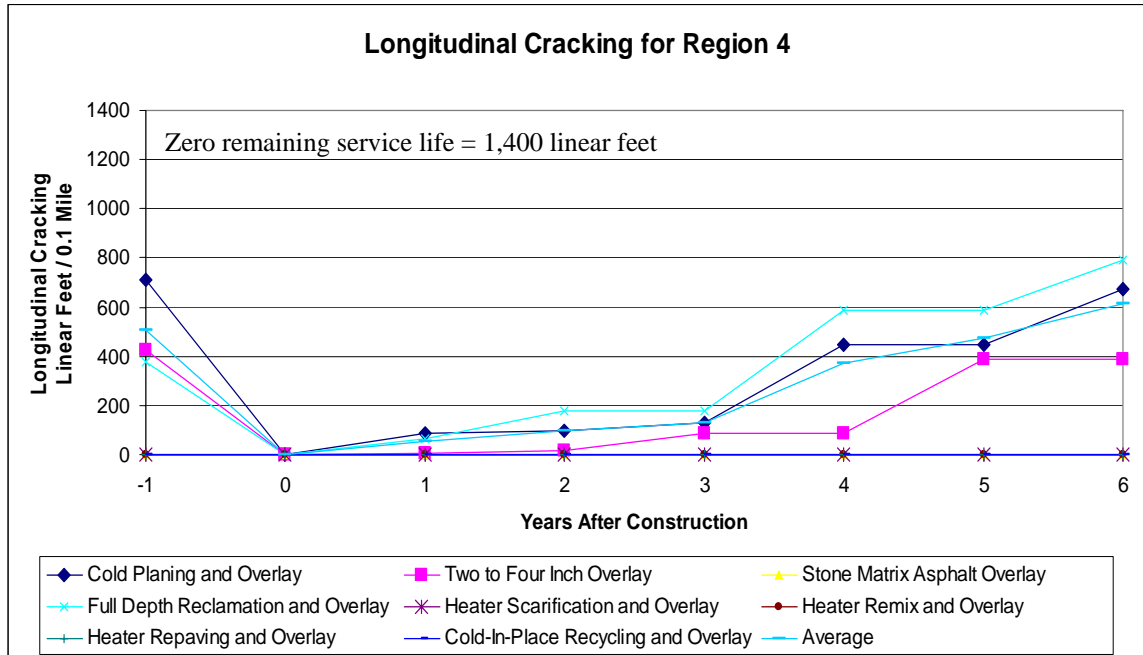


Figure 81 Longitudinal cracking performance after six years in relation to Region 4

Table 85 Longitudinal Cracking Performance – Region 4 Data

| Treatment | Region 4 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|-----|-----|-----|-----|-----|-----|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 712.8 | 0 | 86 | 97 | 131 | 447 | 447 | 671 | 110.1304 | 0.65 | 3.29 |
| Two to Four Inch Overlay | 425.15 | 0 | 7 | 18 | 84 | 84 | 386 | 386 | 70.86466 | 0.446 | 6.14 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | 378.8 | 0 | 67 | 178 | 178 | 584 | 584 | 789 | 136.0798 | 0.523 | 4.57 |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 506 | 0 | 53 | 98 | 131 | 372 | 473 | 616 | 105.6916 | | |

Longitudinal Cracking – Region 4

Stone matrix asphalt overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed the least amount of longitudinal cracking per year. Full-depth reclamation and overlay showed the greatest amount of longitudinal cracking per year as shown in Table 85.

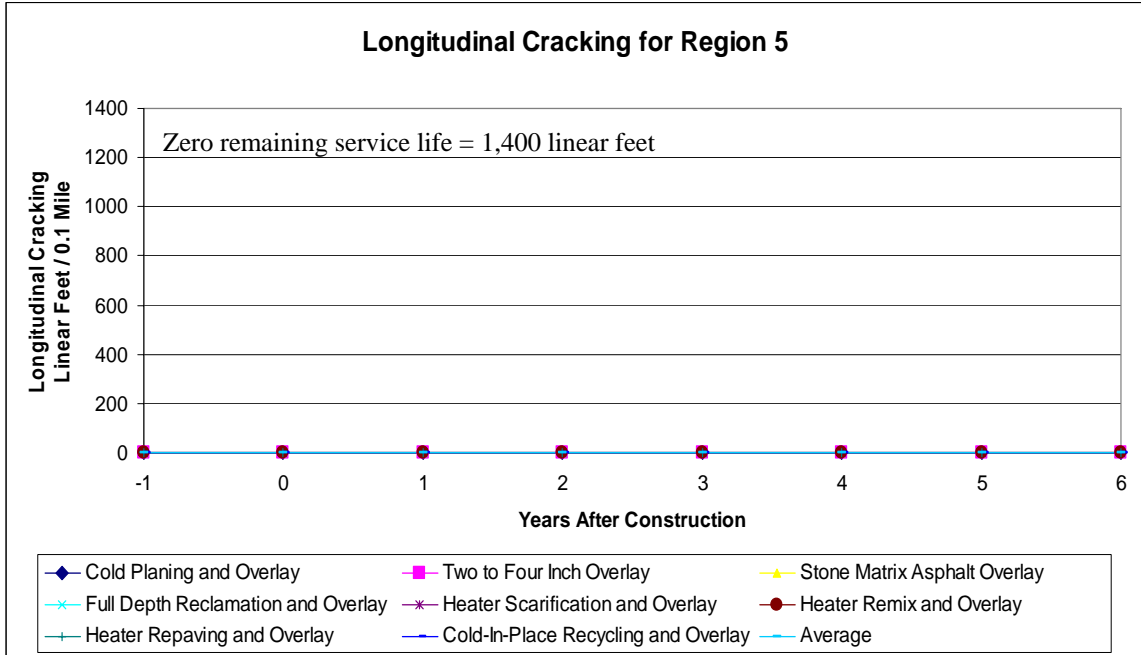


Figure 82 Longitudinal cracking performance after six years in relation to Region 5

Table 86 Longitudinal Cracking Performance – Region 5 Data

| Treatment | Region 5 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|---------|---------|---------|---------|---------|---------|---------|---------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | ---- |

Longitudinal Cracking – Region 5

None of the rehabilitation strategies met the predetermined criteria so an analysis could not be performed.

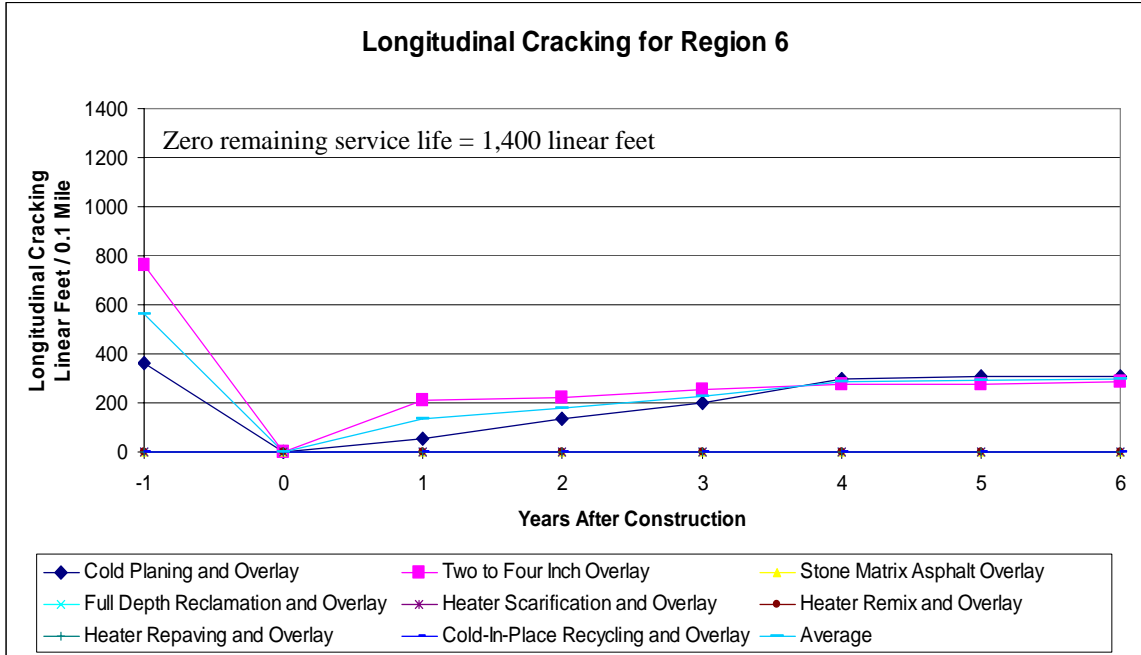


Figure 83 Longitudinal cracking performance after six years in relation to Region 6

Table 87 Longitudinal Cracking Performance – Region 6 Data

| Treatment | Region 6 | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|-----|-----|-----|-----|-----|-----|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 361.1625 | 0 | 56 | 134 | 201 | 299 | 311 | 311 | 57.33556 | 0.728 | 14 |
| Two to Four Inch Overlay | 761.9 | 0 | 211 | 221 | 255 | 274 | 274 | 286 | 37.02381 | 0.633 | 2.71 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 562 | 0 | 134 | 178 | 228 | 286 | 292 | 298 | 47.17968 | | |

Longitudinal Cracking – Region 6

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed the least amount of longitudinal cracking per year compared to the other rehabilitation strategies. Cold planing and overlay showed the most amount of longitudinal cracking per year as shown in Table 87.

CUMMULATIVE INCREASE IN DISTRESSES WITH RELATION TO
ENVIROMENTAL CONDITIONS

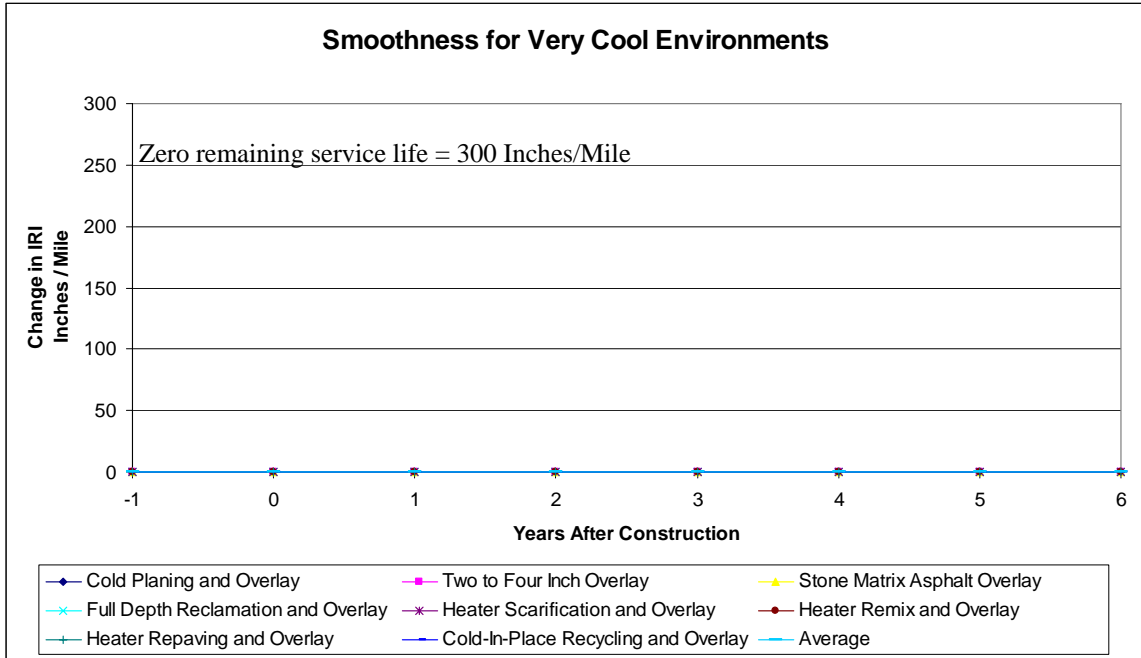


Figure 84 Rate of change for smoothness after six years with relation to average high temperatures of less than 81 degrees F

Table 88 Smoothness Performance – Very Cool Data

| Treatment | Very Cool | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | | | |

Smoothness – Very Cool

None of the rehabilitation strategies met the predetermined criteria so an analysis could not be performed.

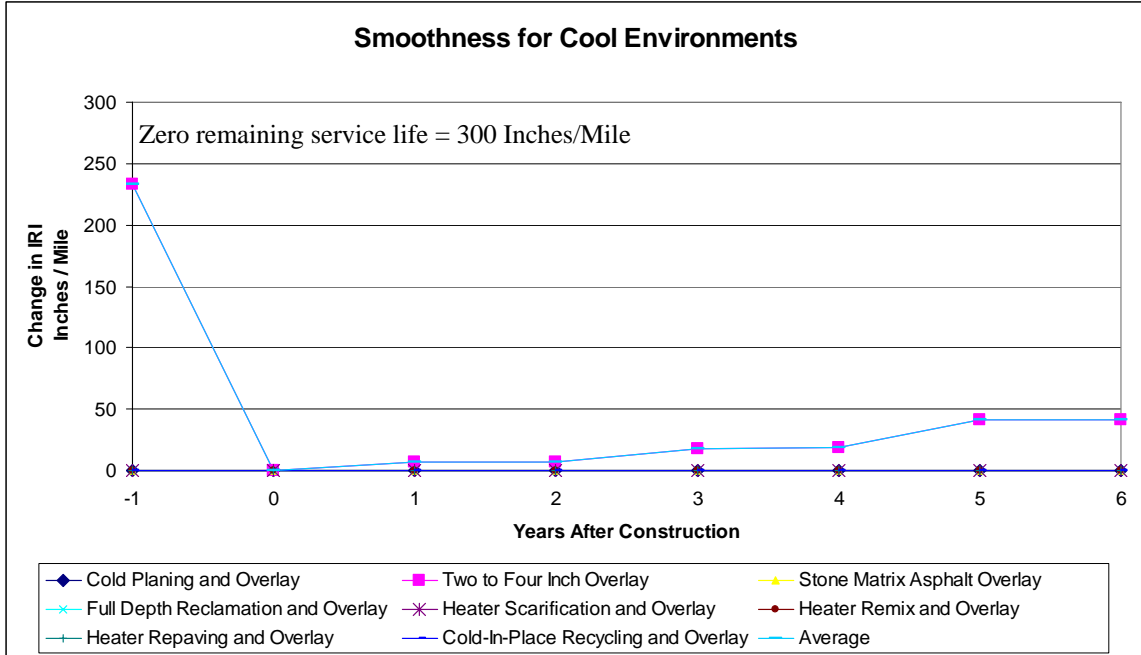


Figure 85 Rate of change for smoothness after six years with relation to average high temperatures from 81 to 88 degrees F

Table 89 Smoothness Performance – Cool Data

| Treatment | Cool | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-------|------|------|------|-------|-------|-------|-------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 233.3 | 0 | 6.68 | 6.68 | 17.74 | 18.68 | 41.12 | 41.12 | 7.293571 | 0.792 | 6 | 6 | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 233 | 0 | 6.68 | 6.68 | 17.74 | 18.68 | 41.12 | 41.12 | 7.293571 | | | | |

Smoothness – Cool

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

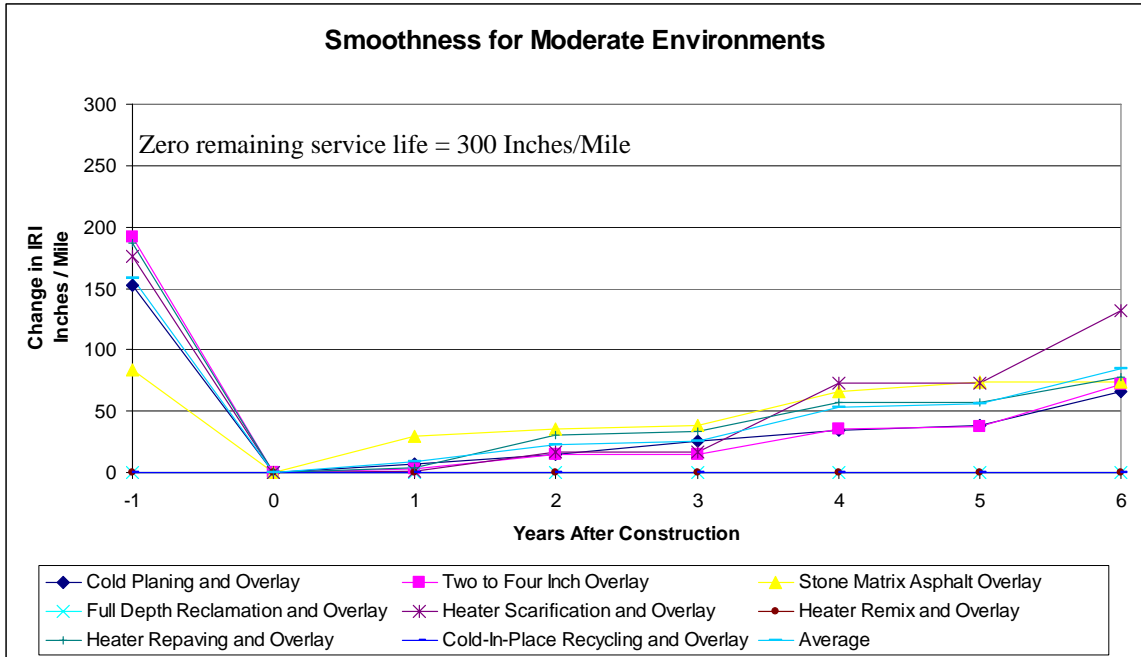


Figure 86 Rate of change for smoothness after six years with relation to average high temperatures from 88 to 97 degrees F

Table 90 Smoothness Performance – Moderate Data

| Treatment | Moderate | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|-------|-------|-------|-------|-------|--------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 152.3889 | 0.00 | 7.14 | 14.88 | 25.20 | 34.22 | 38.60 | 65.56 | 9.96203 | 0.82 | 12.14 |
| Two to Four Inch Overlay | 191.3778 | 0 | 2.57 | 14.68 | 14.68 | 35.65 | 37.52 | 72.02 | 10.96205 | 0.807 | 10.71 |
| Stone Matrix Asphalt Overlay | 83.6 | 0 | 29.04 | 35.08 | 38.12 | 66.04 | 74.13 | 74.13 | 12.26952 | 0.907 | 4 |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 175.8889 | 0 | 0.85 | 16.72 | 16.72 | 72.40 | 72.40 | 131.55 | 21.19378 | 0.813 | 8.29 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | 187.30 | 0 | 4.00 | 30.07 | 33.13 | 57.20 | 57.20 | 77.33 | 13.05476 | 0.912 | 2.86 |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 158 | 0 | 8.72 | 22.29 | 25.57 | 53.10 | 55.97 | 84.12 | 13.48843 | | |

Smoothness – Moderate

Full-depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the greatest performance when compared to the other rehabilitation strategies. Heater scarification and overlay showed the worst performance as shown in Table 90.

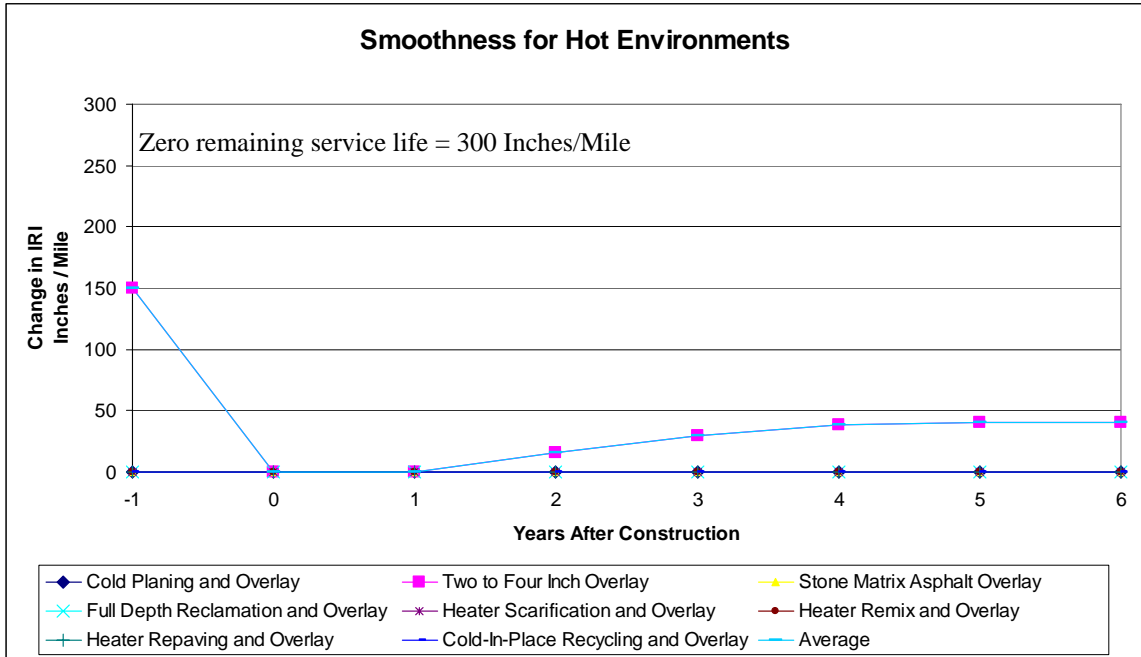


Figure 87 Rate of change for smoothness after six years with relation to average high temperatures greater than 97 degrees F

Table 91 Smoothness Performance – Hot Data

| Treatment | Hot | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-------|------|------|-------|-------|-------|-------|-------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 150.2 | 0 | - | 15.62 | 29.87 | 38.42 | 39.97 | 39.97 | 7.951786 | 0.873 | 4.67 | | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 150 | 0 | 0.00 | 15.62 | 29.87 | 38.42 | 39.97 | 39.97 | 7.951786 | | | | |

Smoothness – Hot

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

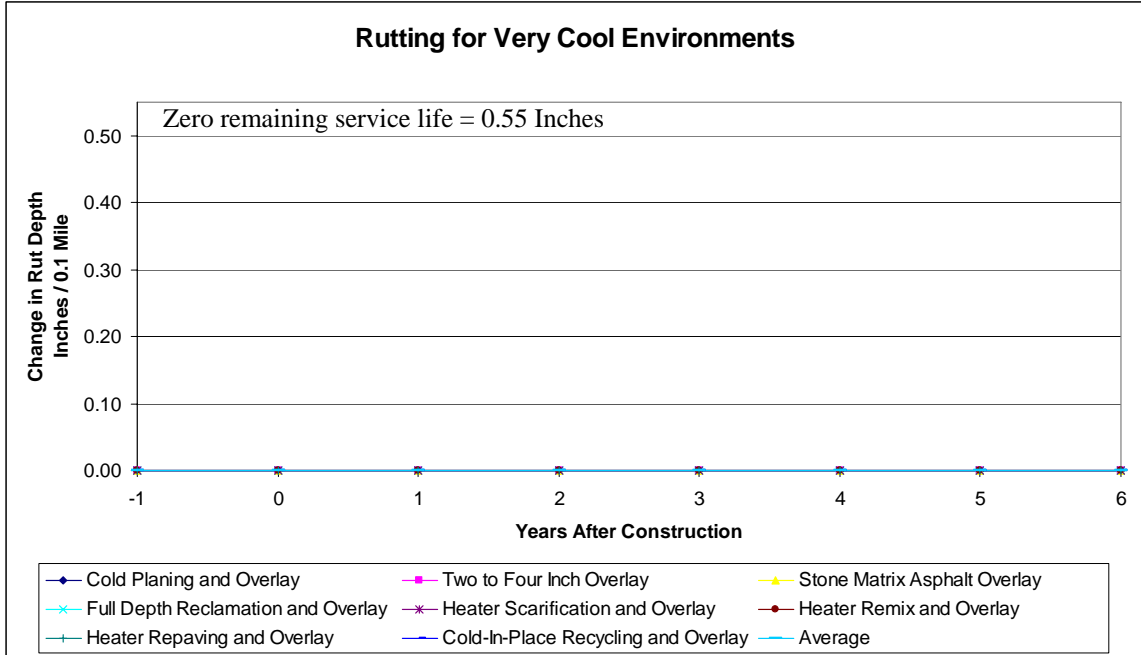


Figure 88 Permanent deformation performance after six years with relation to average high temperatures of less than 81 degrees F

Table 92 Rutting Performance – Very Cool Data

| Treatment | Very Cool | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Two to Four Inch Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | | | |

Rutting – Very Cool

None of the rehabilitation strategies met the predetermined criteria so an analysis could not be performed.

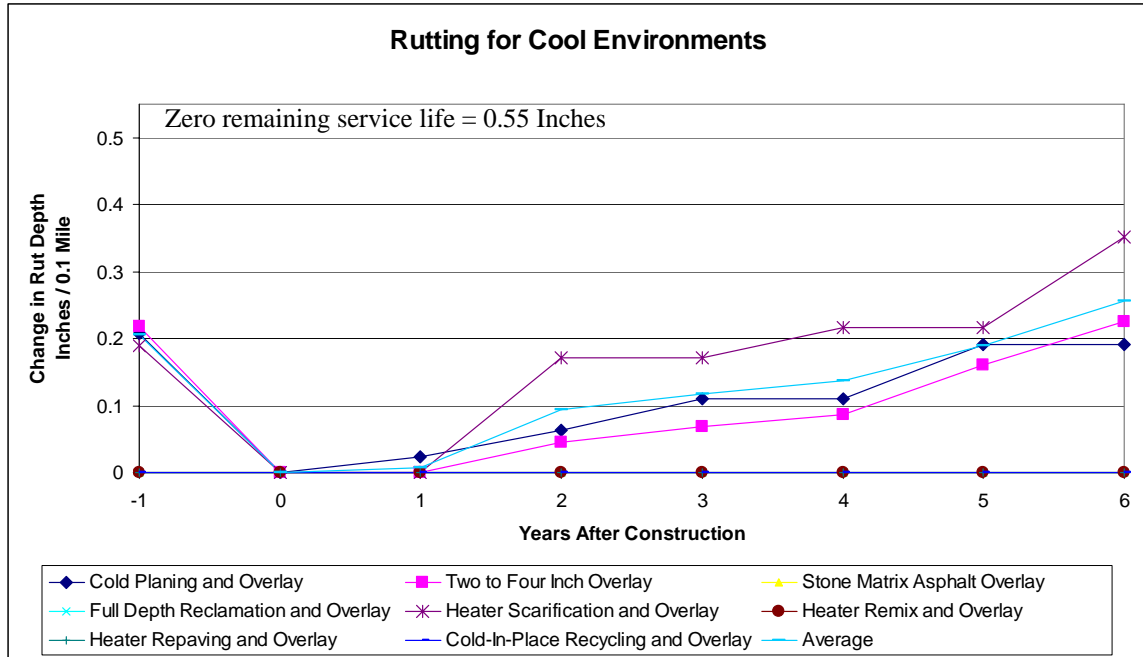


Figure 89 Permanent deformation performance after six years with relation to average high temperatures from 81 to 88 degrees F

Table 93 Rutting Performance – Cool Data

| Treatment | Cool | | | | | | | Slope | R ² | n, Avg | |
|-------------------------------------|--------|------|------|------|------|------|------|-------|----------------|--------|-------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | | | | |
| Cold Planing and Overlay | 0.208 | 0.00 | 0.02 | 0.06 | 0.11 | 0.11 | 0.19 | 0.19 | 0.03408 | 0.809 | 3.57 |
| Two to Four Inch Overlay | 0.2175 | 0 | - | 0.05 | 0.07 | 0.09 | 0.16 | 0.23 | 0.037019 | 0.874 | 11.71 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 0.19 | 0 | - | 0.17 | 0.17 | 0.22 | 0.22 | 0.35 | 0.054607 | 0.818 | 2.86 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 0 | 0 | 0.01 | 0.09 | 0.12 | 0.14 | 0.19 | 0.26 | 0.041902 | | |

Rutting – Cool

Stone matrix asphalt overlay, full depth-reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay and 2 to 4 inch overlay showed similar amounts of rutting per year and performed better than heater scarification and overlay as shown in Table 93.

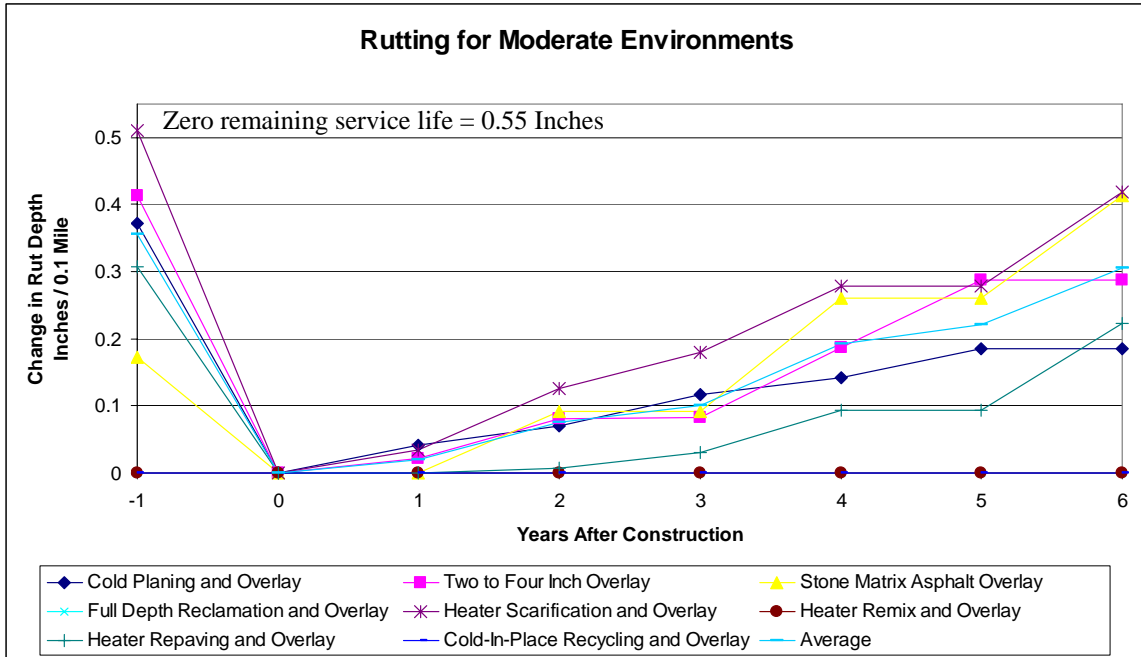


Figure 90 Permanent deformation performance after six years with relation to average high temperatures from 88 to 97 degrees F

Table 94 Rutting Performance – Moderate Data

| Treatment | Moderate | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|------|------|------|------|------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 0.372545 | 0.00 | 0.04 | 0.07 | 0.12 | 0.14 | 0.19 | 0.19 | 0.032713 | 0.865 | 19.57 | |
| Two to Four Inch Overlay | 0.41425 | 0 | 0.02 | 0.08 | 0.08 | 0.19 | 0.29 | 0.29 | 0.053666 | 0.675 | 28.71 | |
| Stone Matrix Asphalt Overlay | 0.172667 | 0 | - | 0.09 | 0.09 | 0.26 | 0.26 | 0.41 | 0.068911 | 0.909 | 3.29 | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | 0.51 | 0 | 0.03 | 0.13 | 0.18 | 0.28 | 0.28 | 0.42 | 0.067976 | 0.798 | 7.57 | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | 0.307 | 0 | - | 0.01 | 0.03 | 0.09 | 0.09 | 0.22 | 0.033429 | 0.936 | 2.86 | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 0 | 0 | 0.02 | 0.08 | 0.10 | 0.19 | 0.22 | 0.31 | 0.051339 | | | |

Rutting – Moderate

Full-depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay and heater repaving and overlay showed the least amounts of rutting per year. Heater scarification and overlay and stone matrix asphalt overlay showed the greatest amounts of rutting per year as shown in Table 94.

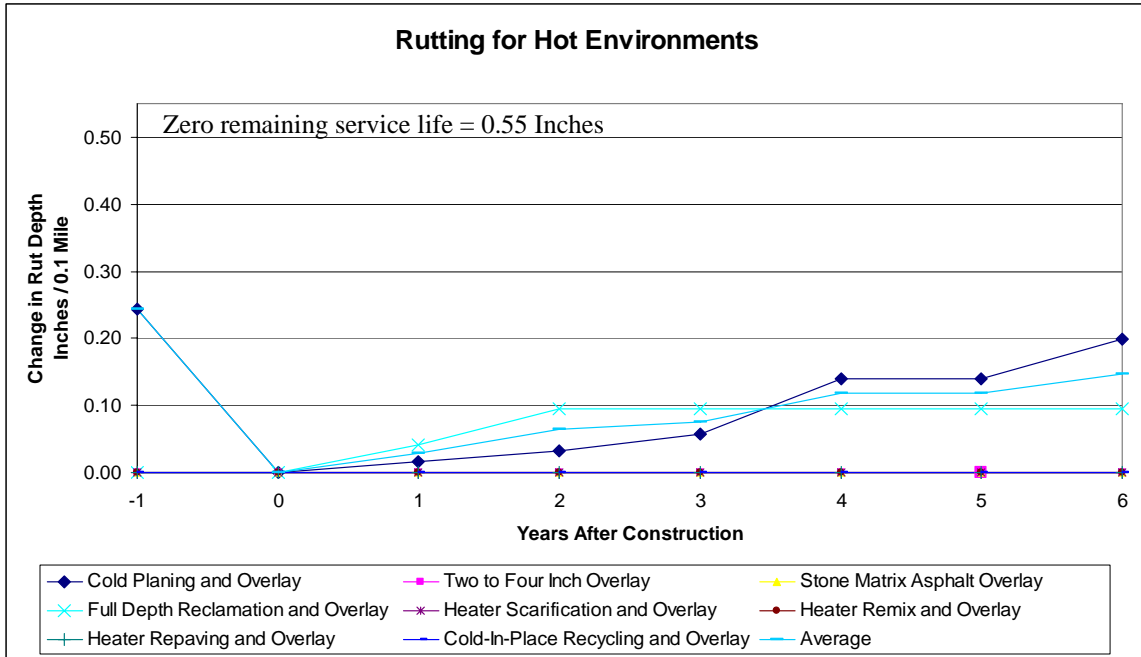


Figure 91 Permanent deformation performance after six years with relation to average high temperatures greater than 97 degrees F

Table 95 Rutting Performance – Hot Data

| Treatment | Hot | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|--------|-----|------|------|------|------|------|------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 0.2445 | 0 | 0.02 | 0.03 | 0.06 | 0.14 | 0.14 | 0.20 | 0.034065 | 0.836 | 5.86 | |
| Two to Four Inch Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Full Depth Reclamation and Overlay | --- | 0 | 0.04 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.013964 | --- | --- | |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Average | 0 | 0 | 0.03 | 0.06 | 0.08 | 0.12 | 0.12 | 0.15 | 0.024015 | --- | --- | |

Rutting – Hot

Cold planing and overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

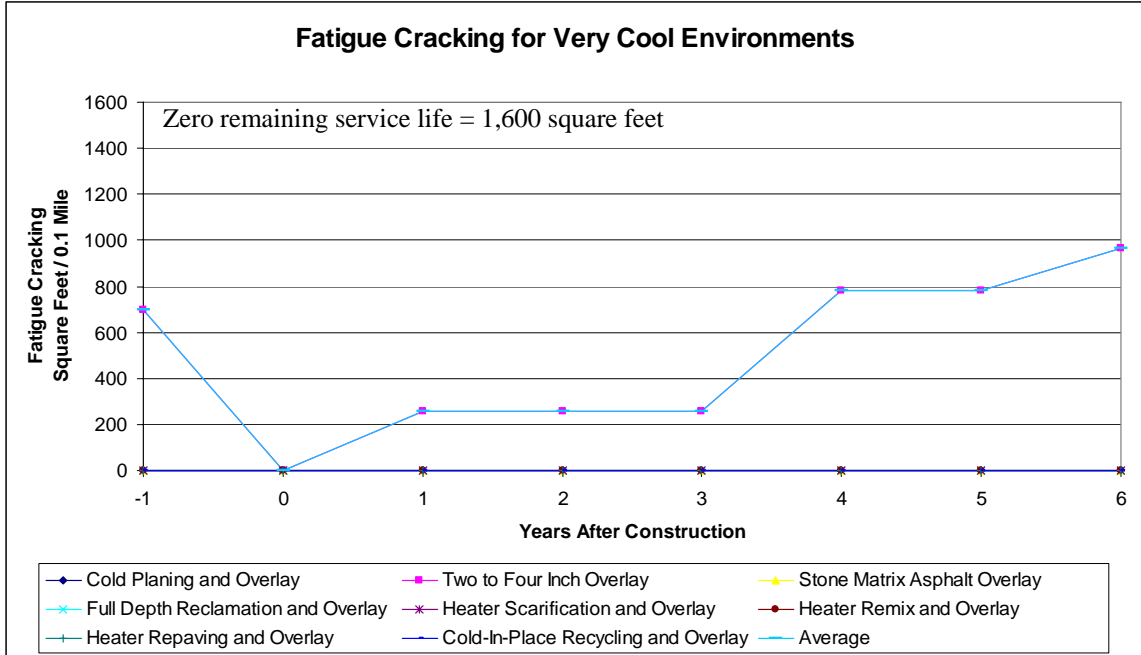


Figure 92 Fatigue cracking performance after six years with relation to average high temperatures of less than 81 degrees F

Table 96 Fatigue Performance – Very Cool Data

| Treatment | Very Cool | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|------------|----------|---------------|---------------|---------------|---------------|---------------|----------------|-----------------|
| | -1 | 0 | 1 | 2 | 3 | 4 | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Two to Four Inch Overlay | 697.8667 | 0 | 254.50 | 259.38 | 259.38 | 780.52 | 780.52 | 967.32 | 159.8256 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 698 | 0 | 254.50 | 259.38 | 259.38 | 780.52 | 780.52 | 967.32 | 159.8256 |

Fatigue – Very Cool

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

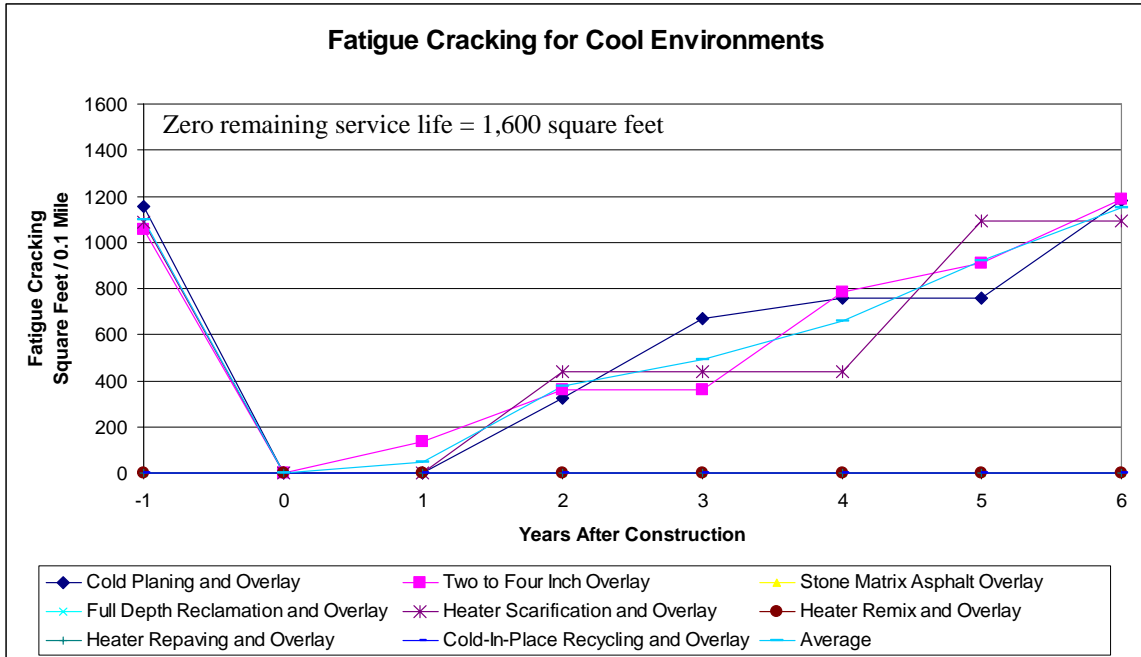


Figure 93 Fatigue cracking performance after six years with relation to average high temperatures from 81 to 88 degrees F

Table 97 Fatigue Performance – Cool Data

| Treatment | Cool | | | | | | Slope | R ² | n, Avg | | |
|-------------------------------------|----------|------|--------|--------|--------|--------|----------|----------------|----------|-------|-------|
| | -1 | 0 | 1 | 2 | 3 | 4 | | | | | |
| Cold Planing and Overlay | 1158 | 0.00 | - | 326.07 | 671.67 | 758.80 | 758.80 | 1,179.17 | 195.994 | 0.639 | 2.86 |
| Two to Four Inch Overlay | 1056.017 | 0 | 134.52 | 358.98 | 358.98 | 783.55 | 908.47 | 1,185.88 | 197.5039 | 0.531 | 11.43 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 1085 | 0 | - | 437.15 | 437.15 | 437.15 | 1,090.50 | 1,090.50 | 194.7321 | 0.8 | 3.71 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 1100 | 0 | 44.84 | 374.06 | 489.26 | 659.83 | 919.26 | 1151.85 | 196.0767 | | |

Fatigue – Cool

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. All rehabilitation strategies that met the predetermined criteria showed similar amounts of fatigue cracking per year. Heater scarification and overlay had the greatest amount of significance with the data as shown in Table 97.

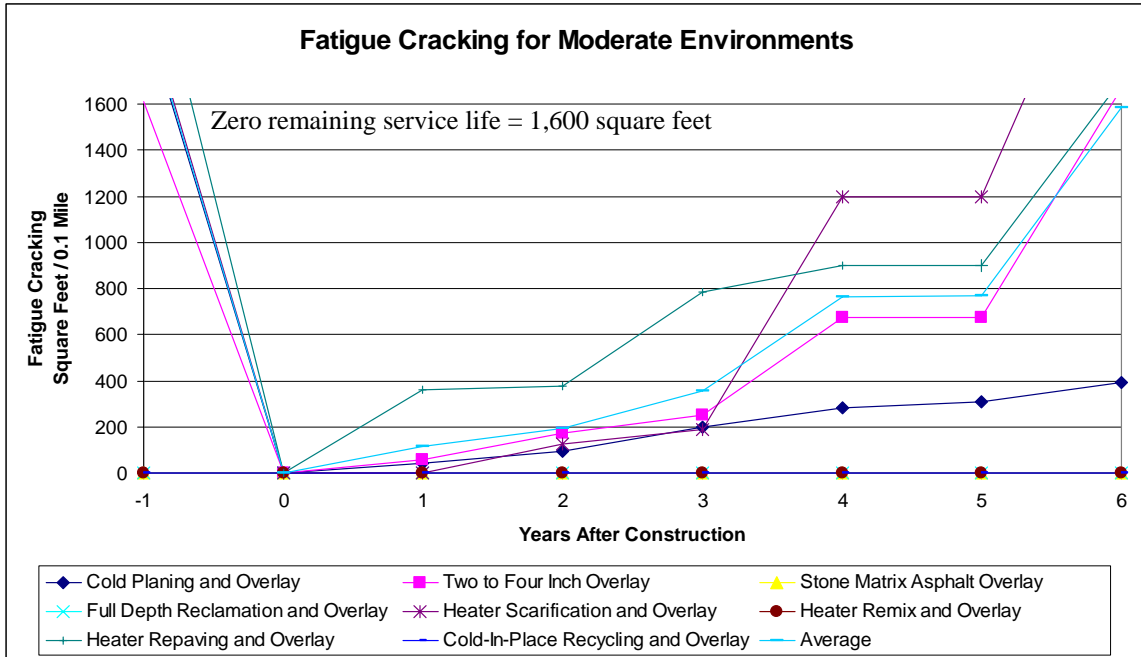


Figure 94 Fatigue cracking performance after six years with relation to average high temperatures from 88 to 97 degrees F

Table 98 Fatigue Performance – Moderate Data

| Treatment | Moderate | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|--------|--------|--------|----------|----------|----------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 2005.2 | 0.00 | 43.65 | 92.36 | 196.45 | 282.88 | 308.08 | 391.11 | 67.59637 | 0.624 | 23.71 |
| Two to Four Inch Overlay | 1608.513 | 0 | 58.71 | 174.19 | 251.92 | 676.45 | 676.45 | 1,666.85 | 240.6537 | 0.398 | 23.86 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 2050.5 | 0 | - | 124.45 | 190.49 | 1,197.95 | 1,197.95 | 2,582.42 | 400.5947 | 0.649 | 5.86 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | 2429.1 | 0 | 361.45 | 377.60 | 783.00 | 899.35 | 899.35 | 1,702.05 | 239.4179 | 0.697 | 3.71 |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 2023 | 0 | 115.95 | 192.15 | 355.46 | 764.16 | 770.46 | 1585.61 | 237.0657 | | |

Fatigue – Moderate

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed significantly less amounts of fatigue cracking a year than the other rehabilitation strategies. Heater scarification and overlay showed a significantly higher rate of fatigue cracking per year as shown in Table 98.

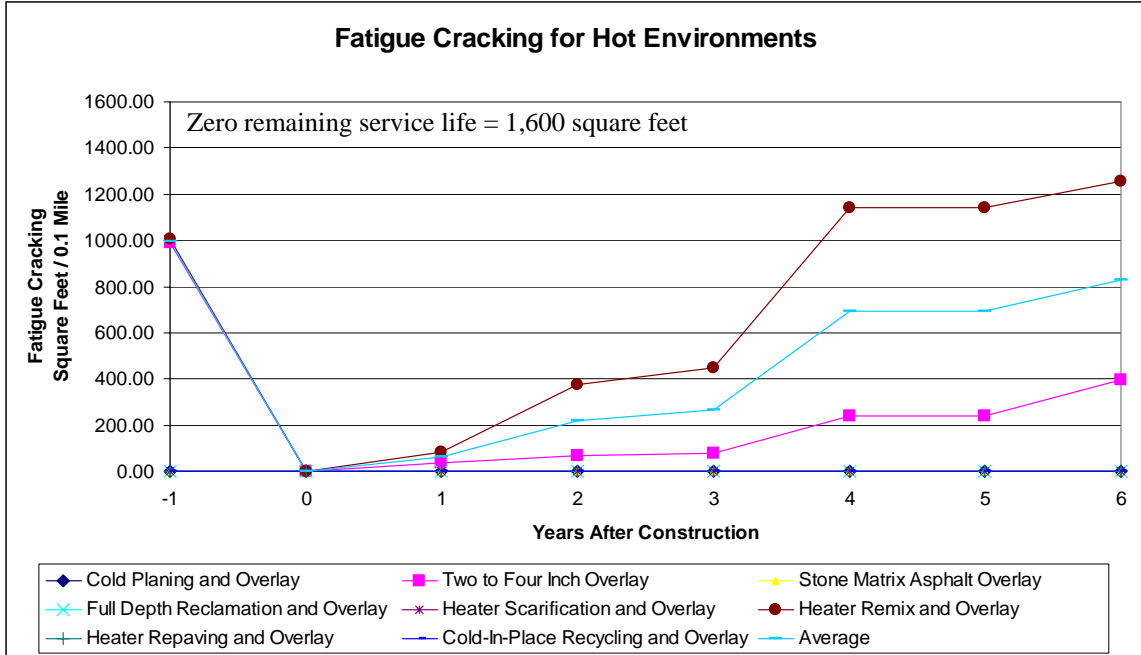


Figure 95 Fatigue cracking performance after six years with relation to average high temperatures greater than 97 degrees F

Table 99 Fatigue Performance – Hot Data

| Treatment | Hot | | | | | | Slope | R ² | n, Avg | |
|-------------------------------------|--------|------|-------|--------|--------|----------|----------|----------------|--------|------|
| | -1 | 0 | 1 | 2 | 3 | 4 | | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Two to Four Inch Overlay | 988.5 | 0 | 38.54 | 67.64 | 80.00 | 241.44 | 241.44 | 63.22908 | 0.357 | 6 |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Heater Remix and Overlay | 1006.4 | 0.00 | 85.80 | 375.00 | 447.40 | 1,142.07 | 1,142.07 | 237.6464 | 0.609 | 2.71 |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | 997 | 0 | 62.17 | 221.32 | 263.70 | 691.75 | 691.75 | 150.4378 | | |

Fatigue – Hot

Cold planing and overlay, stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed significantly less fatigue cracking than the heater remix and overlay rehabilitation strategy as shown in Table 99.

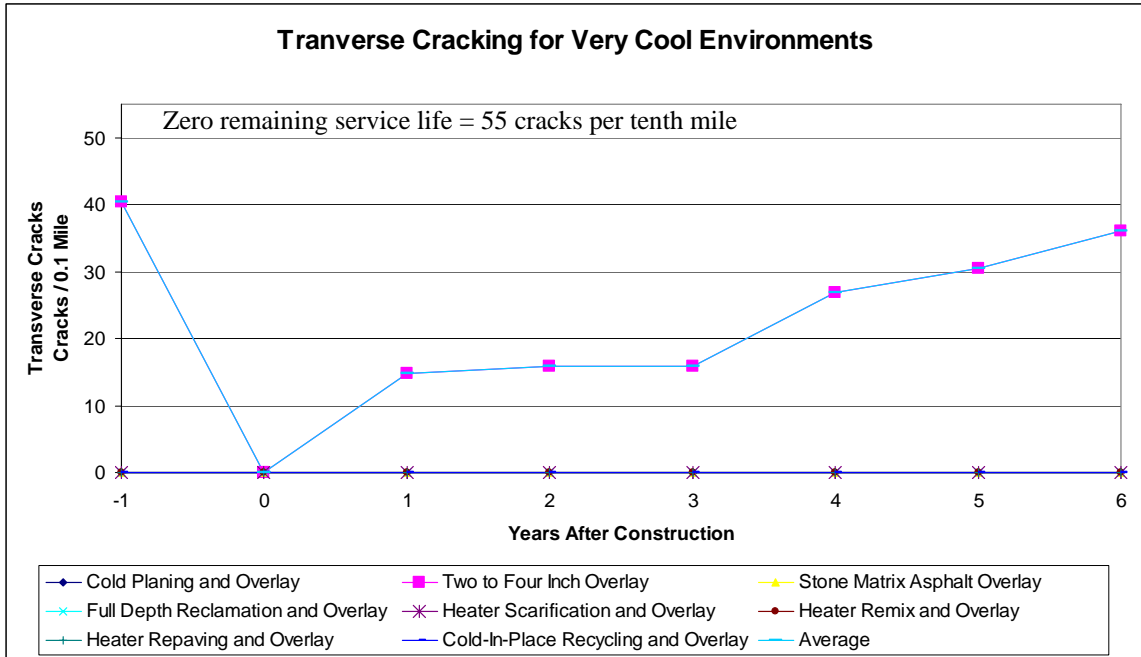


Figure 96 Transverse cracking performance after six years with relation to average high temperatures of less than 81 degrees F

Table 100 Transverse Cracking Performance – Very Cool Data

| Treatment | Very Cool | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-----------|----------|--------------|--------------|--------------|--------------|--------------|--------------|-----------------|------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 40.48 | 0 | 14.75 | 15.85 | 15.85 | 26.85 | 30.39 | 36.02 | 5.368929 | 0.86 | 4.57 | | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 40 | 0 | 14.75 | 15.85 | 15.85 | 26.85 | 30.39 | 36.02 | 5.368929 | | | | |

Transverse Cracking – Very Cool

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

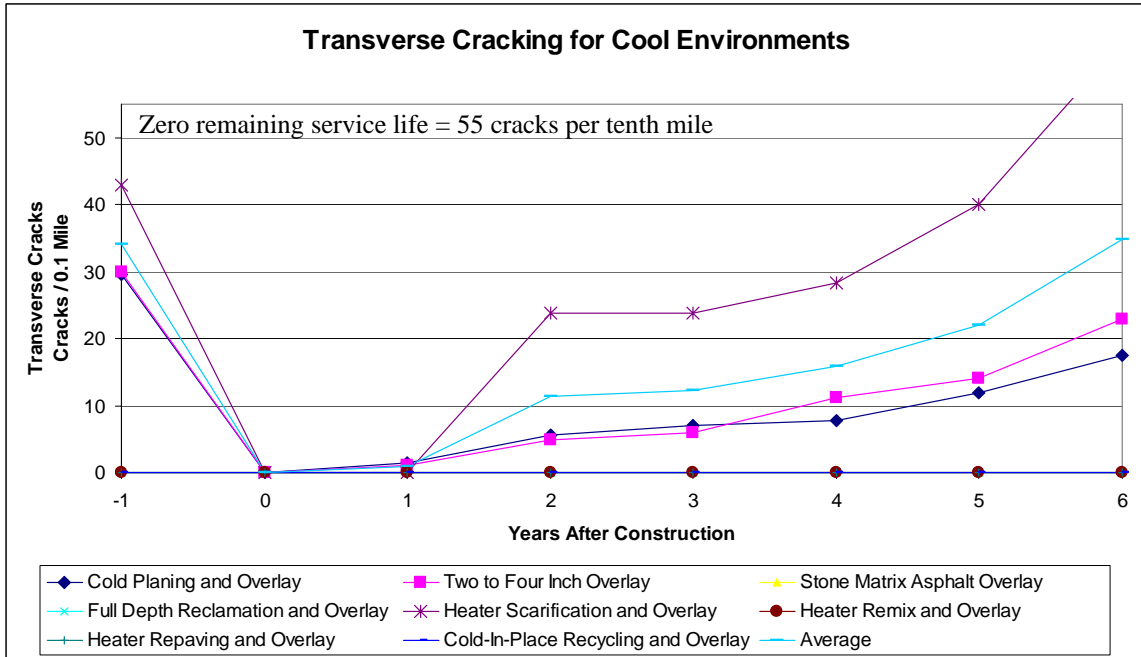


Figure 97 Transverse cracking performance after six years with relation to average high temperatures from 81 to 88 degrees F

Table 101 Transverse Cracking Performance – Cool Data

| Treatment | Cool | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|-------|-------|-------|-------|-------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 29.5 | 0.00 | 1.40 | 5.50 | 7.00 | 7.80 | 11.90 | 17.50 | 2.707143 | 0.784 | 3.71 |
| Two to Four Inch Overlay | 29.92308 | 0 | 1.16 | 4.81 | 5.97 | 11.21 | 14.07 | 22.83 | 3.596628 | 0.711 | 15 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 43 | 0 | - | 23.73 | 23.73 | 28.37 | 39.97 | 64.27 | 9.905952 | 0.688 | 3.57 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 34 | 0 | 0.85 | 11.35 | 12.24 | 15.79 | 21.98 | 34.87 | 5.403241 | | |

Transverse Cracking – Cool

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Heater scarification and overlay showed significantly more transverse cracking per year than the other rehabilitation strategies as shown in Table 101.

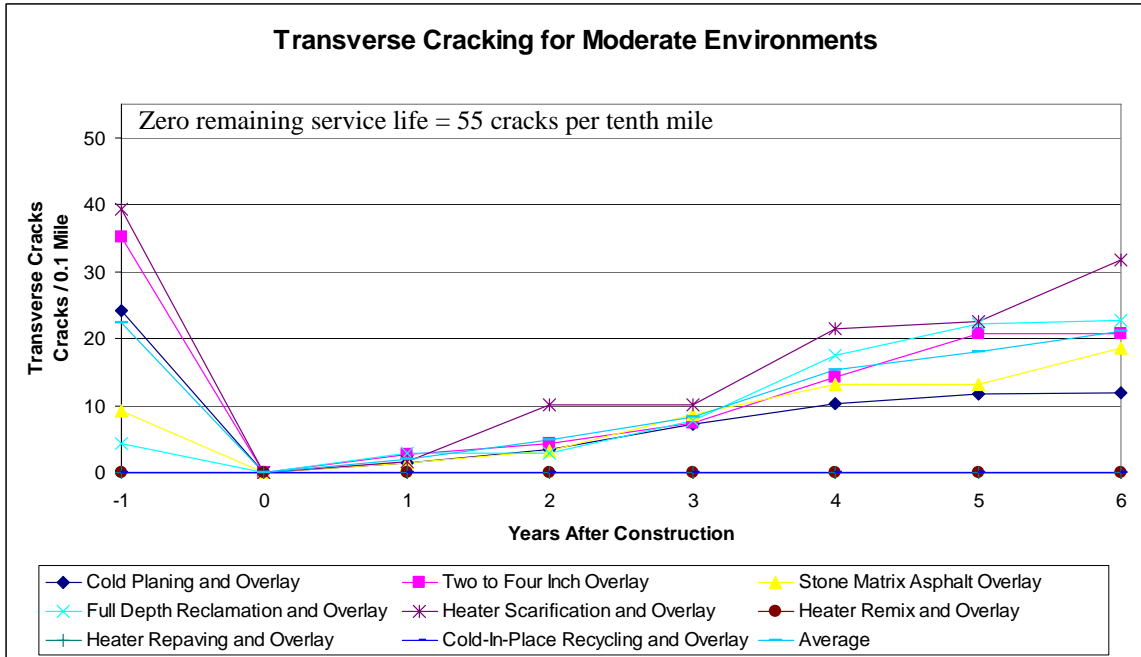


Figure 98 Transverse cracking performance after six years with relation to average high temperatures from 88 to 97 degrees F

Table 102 Transverse Cracking Performance – Moderate Data

| Treatment | Moderate | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|------|-------|-------|-------|-------|-------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 24.16757 | 0.00 | 1.52 | 3.50 | 7.29 | 10.22 | 11.68 | 11.84 | 2.23504 | 0.683 | 33 |
| Two to Four Inch Overlay | 35.24 | 0 | 2.66 | 4.38 | 7.40 | 14.31 | 20.67 | 20.67 | 3.854581 | 0.695 | 30.43 |
| Stone Matrix Asphalt Overlay | 9.133333 | 0 | 1.44 | 3.20 | 8.68 | 13.24 | 13.24 | 18.51 | 3.184286 | 0.611 | 4.14 |
| Full Depth Reclamation and Overlay | 4.4 | 0 | 2.95 | 2.95 | 7.75 | 17.55 | 22.18 | 22.68 | 4.325595 | 0.749 | 3 |
| Heater Scarification and Overlay | 39.28889 | 0 | 1.56 | 10.04 | 10.04 | 21.43 | 22.48 | 31.72 | 5.298481 | 0.753 | 8.29 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 22 | 0 | 2.03 | 4.81 | 8.23 | 15.35 | 18.05 | 21.08 | 3.779597 | | |

Transverse Cracking – Moderate

Heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay showed the least amount of transverse cracking per year. Heater scarification and overlay showed the greatest amount of transverse cracking per year as shown in Table 102.

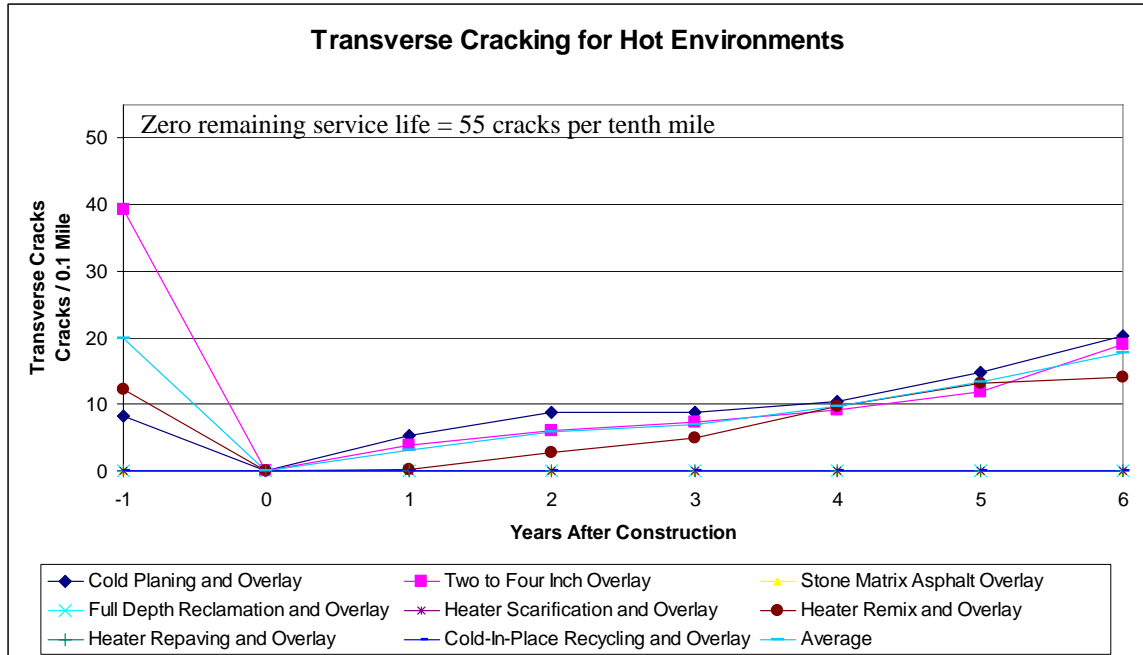


Figure 99 Transverse cracking performance after six years with relation to average high temperatures greater than 97 degrees F

Table 103 Transverse Cracking Performance – Hot Data

| Treatment | Hot | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|------|------|------|------|------|-------|-------|-------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | 8.3 | 0 | 5.38 | 8.68 | 8.68 | 10.33 | 14.88 | 20.35 | 2.917857 | 0.845 | 3.43 | |
| Two to Four Inch Overlay | 39.3 | 0 | 3.92 | 5.98 | 7.39 | 9.23 | 11.90 | 18.92 | 2.71252 | 0.795 | 8 | |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Scarification and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Remix and Overlay | 12.2 | 0.00 | 0.20 | 2.73 | 4.93 | 9.67 | 13.20 | 14.10 | 2.686905 | 0.882 | 2.71 | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Average | 20 | 0 | 3.17 | 5.80 | 7.00 | 9.74 | 13.33 | 17.79 | 2.772427 | | | |

Transverse Cracking – Hot

Stone matrix asphalt overlay, full-depth reclamation and overlay, heater scarification and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. The three rehabilitation strategies that met the predetermined criteria all showed similar amounts of transverse cracking per year as shown in Table 103.

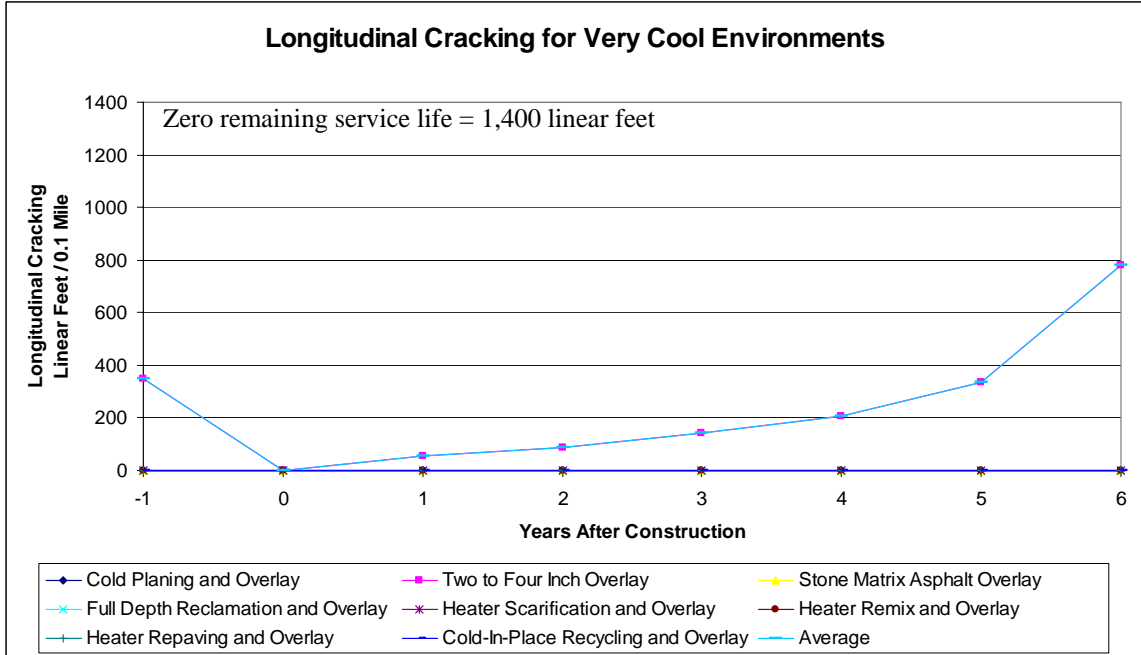


Figure 100 Longitudinal cracking performance after six years with relation to average high temperatures of less than 81 degrees F

Table 104 Longitudinal Cracking Performance – Very Cool Data

| Treatment | Very Cool | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-----------|------|-------|-------|--------|--------|--------|--------|----------------|------------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 350.75 | 0 | 56.15 | 88.63 | 144.55 | 208.68 | 333.21 | 781.48 | 107.808 | 0.882 3.43 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 351 | 0 | 56.15 | 88.63 | 144.55 | 208.68 | 333.21 | 781.48 | 107.808 | |

Longitudinal Cracking – Very Cool

Two to 4-inch overlay is the only rehabilitation strategy represented in this section so an analysis could not be done.

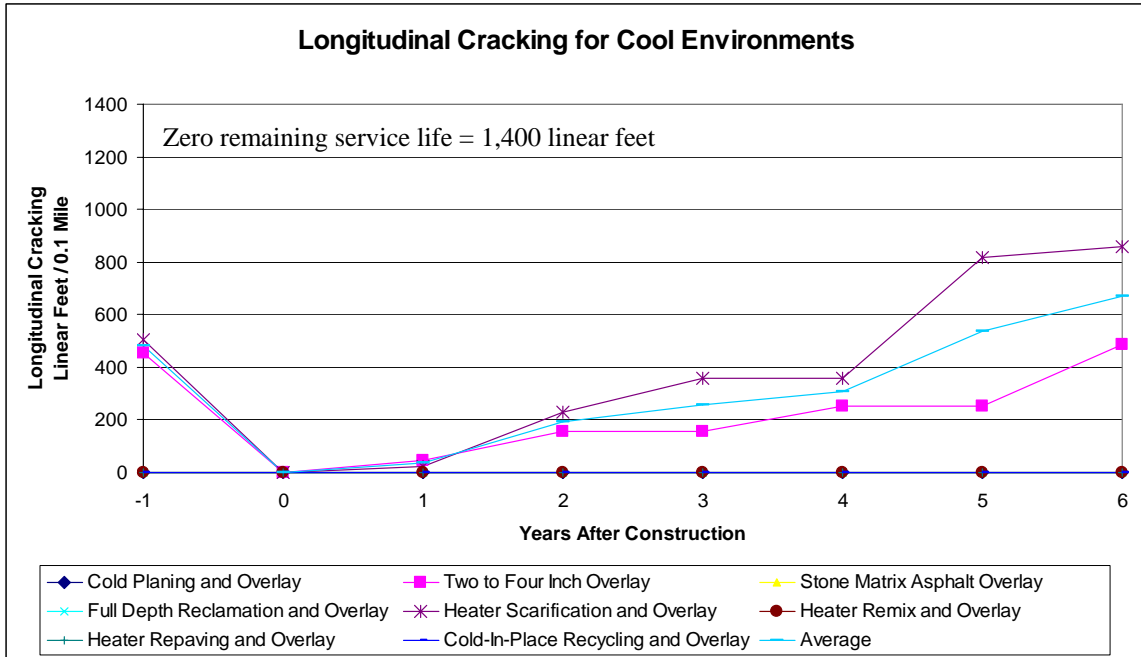


Figure 101 Longitudinal cracking performance after six years with relation to average high temperatures from 81 to 88 degrees F

Table 105 Longitudinal Cracking Performance – Cool Data

| Treatment | Cool | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|-----|-------|--------|--------|--------|--------|--------|----------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| Cold Planing and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Two to Four Inch Overlay | 455.5333 | 0 | 48.04 | 154.70 | 155.05 | 253.93 | 253.93 | 487.67 | 70.49972 | 0.703 | 7.86 | |
| Stone Matrix Asphalt Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Full Depth Reclamation and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Scarification and Overlay | 504.4 | 0 | 23.64 | 228.43 | 358.55 | 358.55 | 818.17 | 856.28 | 153.1436 | 0.763 | 4 | |
| Heater Remix and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Heater Repaving and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Cold-In-Place Recycling and Overlay | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Average | 480 | 0 | 35.84 | 191.57 | 256.80 | 306.24 | 536.05 | 671.98 | 111.8216 | | | |

Longitudinal Cracking – Cool

Cold planing and overlay, stone matrix asphalt overlay, full-depth reclamation and overlay, heater remix and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed significantly less longitudinal cracking than heater scarification and overlay, the other rehabilitation strategy that met the criteria as shown in Table 105.

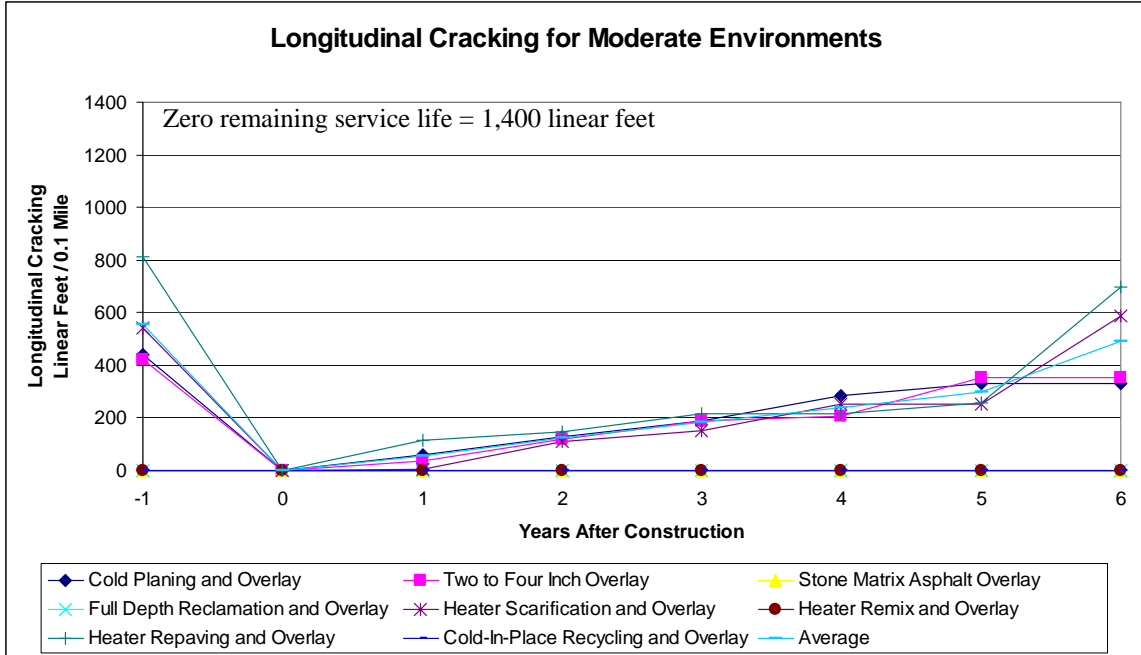


Figure 102 Longitudinal cracking performance after six years with relation to average high temperatures from 88 to 97 degrees F

Table 106 Longitudinal Cracking Performance – Moderate Data

| Treatment | Moderate | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|----------|------|--------|--------|--------|--------|--------|--------|----------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| Cold Planing and Overlay | 439.79 | 0.00 | 59.48 | 126.36 | 186.62 | 285.14 | 332.02 | 332.02 | 60.71151 | 0.718 | 23.57 |
| Two to Four Inch Overlay | 420.4632 | 0 | 38.51 | 118.85 | 188.74 | 208.16 | 353.36 | 353.36 | 63.53889 | 0.57 | 20.17 |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Scarification and Overlay | 543.3467 | 0 | 3.63 | 111.10 | 149.84 | 252.68 | 252.68 | 588.38 | 85.88589 | 0.697 | 7.43 |
| Heater Remix and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Heater Repaving and Overlay | 814.6 | 0 | 115.10 | 146.77 | 214.50 | 214.50 | 256.17 | 699.97 | 87.49167 | 0.8 | 2.86 |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Average | 555 | 0 | 54.18 | 125.77 | 184.93 | 240.12 | 298.56 | 493.43 | 74.40699 | | |

Longitudinal Cracking – Moderate

Full-depth reclamation and overlay, Heater remix and overlay, and cold-in-place recycling and overlay are not represented. Cold planing and overlay and 2 to 4-inch overlay showed the least amounts of longitudinal cracking per year. Heater scarification and overlay, and heater repaving and overlay showed the greatest amounts of longitudinal cracking per year as shown in Table 105.

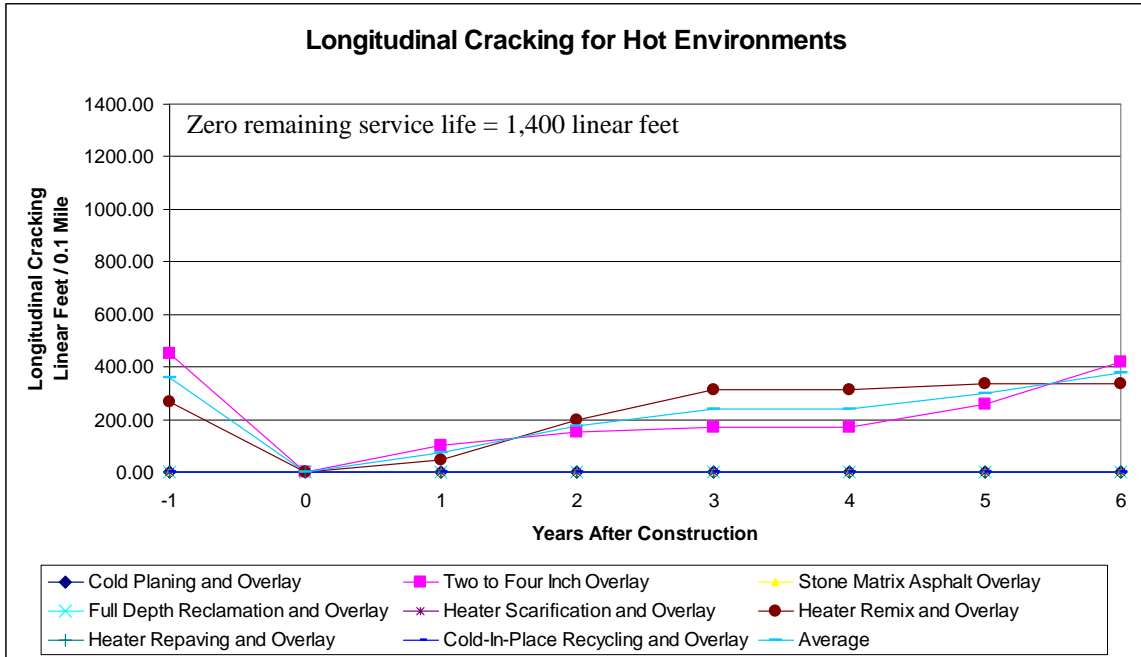


Figure 103 Longitudinal cracking performance after six years with relation to average high temperatures greater than 97 degrees F

Table 107 Longitudinal Cracking Performance – Hot Data

| Treatment | Hot | | | | | | | | | | Slope | R ² | n, Avg |
|-------------------------------------|-------|------|-------|--------|--------|--------|--------|--------|----------|-------|-------|----------------|--------|
| | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Cold Planing and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Two to Four Inch Overlay | 449.4 | 0 | 99.15 | 153.67 | 169.40 | 169.40 | 257.95 | 417.24 | 56.60935 | 0.496 | 5.83 | ---- | |
| Stone Matrix Asphalt Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Full Depth Reclamation and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Scarification and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Heater Remix and Overlay | 267.9 | 0 | 46.27 | 197.25 | 313.60 | 313.60 | 336.30 | 336.30 | 60.90417 | 0.723 | 3.29 | ---- | |
| Heater Repaving and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Cold-In-Place Recycling and Overlay | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | |
| Average | 359 | 0 | 72.71 | 175.46 | 241.50 | 241.50 | 297.13 | 376.77 | 58.75676 | ---- | ---- | ---- | |

Longitudinal Cracking – Hot

Cold planing and overlay, full-depth reclamation and overlay, heater scarification and overlay, heater repaving and overlay, and cold-in-place recycling and overlay are not represented. Two to 4-inch overlay showed less longitudinal cracking per year. Heater remix and overlay showed the greatest amount of longitudinal cracking per year as shown in Table 107.

5.0 ANALYSIS

Analysis was done to determine which rehabilitation strategy performed best and which strategy performed worst. Analysis was also done to determine the average time it takes for each distress to return to its condition prior to rehabilitation when there is no application of variables to data.

Numbers provided in Tables 108 and 109 represent the number of times a rehabilitation strategy performed best and worst respectively. For analysis purposes, rehabilitation strategies are summarized by how many times they performed the best and worst. In the other instances when rehabilitation strategies performed with the average or did not meet predetermined criteria they are not reported in Tables 108 and 109.

Performance is measured by the overall deterioration over time. The rate of deterioration over time is represented as a linear slope. The slope is the main contributing factor in determining if a rehabilitation strategy performed well. Table 108 shows how many times rehabilitation strategies performed better than others in various situations.

Cold planing and overlay had the most occurrences of performing best compared to the other rehabilitation strategies. Therefore, cold planing and overlay performed best in the majority of the graphs and tables. This conclusion was made by looking at the slopes of the deteriorations. The slope for the rate of deterioration over time for cold planing and overlay in the majority of the situations was less than those of other strategies.

Table 108 Summary of Graphs and Tables Performing Best

| Rehabilitation Strategy | Number of Graphs Performed Best |
|-------------------------------------|--|
| Cold Planing and Overlay | 53 |
| 2 to 4-Inch Overlay | 27 |
| Heater Remix and Overlay | 5 |
| Heater Repaving and Overlay | 3 |
| Stone Matrix Asphalt Overlay | 2 |
| Heater Scarification and Overlay | 1 |
| Full Depth Reclamation and Overlay | 0 |
| Cold-In-Place Recycling and Overlay | 0 |

For example, Table 4 “Fatigue Performance – All Data” shows that cold planing and overlay has a slope of deterioration over time of 86.42 square feet of fatigue cracking per 0.1 mile. The other rehabilitation strategies slope of deterioration range from 191 to 275.77 square feet of fatigue cracking per 0.1 mile. Therefore, cold planing and overlay showed better performance than other rehabilitation strategies for this example. The same analysis was done for all 100 data tables and graphs. Table 108 summarizes what the results were.

Table 109 is a representation of the number of time each rehabilitation strategy showed the most amounts of deterioration over time. The majority of the projects that showed the greatest slopes of deterioration over time were rehabilitated using the heater scarification and overlay strategy.

Table 109 Summary of Graphs and Tables Performing Worst

| Rehabilitation Strategy | Number of Graphs Performed Worst |
|-------------------------------------|---|
| Heater Scarification and Overlay | 34 |
| 2 to 4-Inch Overlay | 12 |
| Heater Remix and Overlay | 9 |
| Cold-in-Place Recycling and Overlay | 9 |
| Full Depth Reclamation and Overlay | 6 |
| Heater Repaving and Overlay | 6 |
| Cold Planing and Overlay | 2 |
| Stone Matrix Asphalt Overlay | 1 |

For example, Table 24 “Fatigue Performance – Moderate Traffic Data” shows that heater scarification and overlay has a slope of deterioration of 423.67 square feet of fatigue cracking per 0.1 mile. The rest of the rehabilitation strategies have slopes of deterioration ranging from 92.94 to 287.03 square feet of fatigue cracking per 0.1 mile. Heater scarification and overlay showed greater amounts of fatigue cracking per year than the other rehabilitation strategies so heater scarification and overlay performed the worst. The same analysis was done for all 100 data tables and graphs. Table 109 summarizes the results.

There were twenty data tables and graphs that had only one rehabilitation strategy that met the predetermined criteria. Four data tables and graphs did not have any rehabilitation strategies that met the predetermined criteria and therefore contain no data points or lines.

Analysis was also done to determine the amount of time it takes for a distress to return to its condition prior to rehabilitation. To calculate the time it takes a distress to reach the condition prior to rehabilitation, the distress in year negative one is divided by the linear slope. On the average, when looking at all the data without application of the variables, the following calculations and conclusions can be made:

Smoothness in year negative one is 162.75 in/mile. The slope of the graph shows a deterioration of 11.0073 in/mile/year. The number of years it takes for smoothness to return to its condition prior to rehabilitation is approximately 14 years $(162.75 \text{ in/mile}) / (11.0073 \text{ in/mile/year})$.

Rutting in year negative one is 0.322547 in/mile. The slope of the graph shows a deterioration of 0.044288 in/mile/year. The number of years it takes for rutting to return to its condition prior to rehabilitation is approximately 7 years $(0.322547 \text{ inches/mile}) / (.044288 \text{ in/mile/year})$.

Fatigue cracking in year negative one is 1195.134 square feet. The slope of the graph shows a deterioration of 153.675 square feet/year. The number of years it takes for rutting to return to its condition prior to rehabilitation is approximately 8 years $(1195.134 \text{ square feet}) / (153.675 \text{ square feet/year})$.

Transverse cracking in year negative one is 23.75 cracks. The slope of the graph shows a deterioration of 3.97469 cracks/year. The number of years it takes for transverse cracking to return to its condition prior to rehabilitation is approximately 6 years $(23.57 \text{ cracks}) / (3.97469 \text{ cracks/year})$.

Longitudinal cracking in year negative one is 506.3918 linear feet. The slope of the graph shows a deterioration of 89.06 linear feet/year. The number of years it takes longitudinal cracking to return to its condition prior to rehabilitation is approximately 6 years (506.3918 linear feet) / (89.05633 linear feet / year). With the exception of smoothness the average time it takes the distress to return to its condition prior to rehabilitation is between 6 and 8 years. Smoothness takes approximately 14 years to return to its condition prior to rehabilitation.

The condition of the pavements prior to rehabilitation is important to understand when analyzing this data. Pavements in the poorest condition prior to rehabilitation should not be expected to perform as well as pavements rehabilitated before they reach very poor condition. Therefore, the following analysis was performed to show not only the average pavement condition prior to rehabilitation, but also the range of pavement condition for each rehabilitation strategy. Figures 104 to 108 indicate the average pavement condition for each rehabilitation strategy, the average for all strategies, and the threshold of zero-remaining service life.

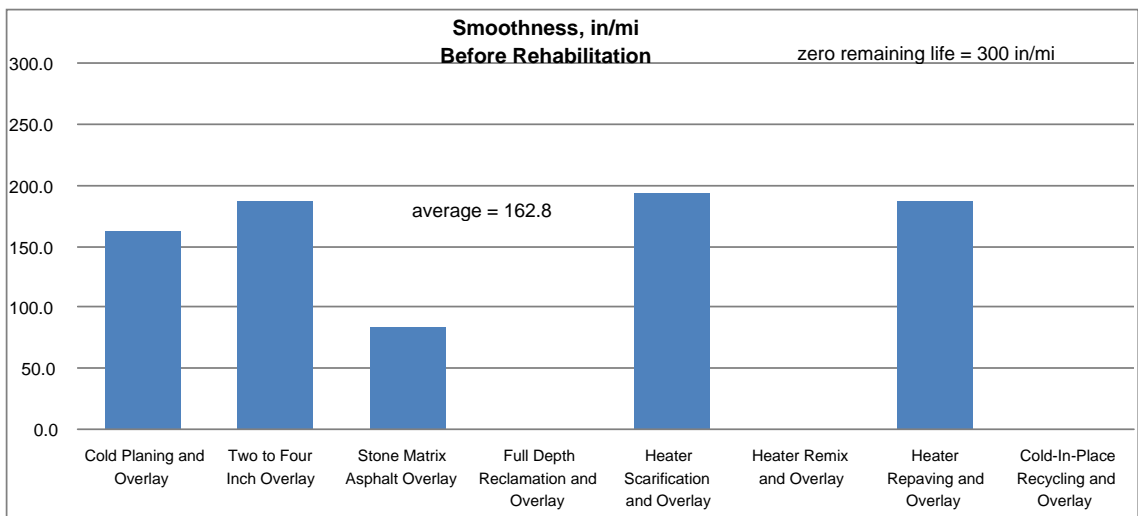


Figure 104 – Average smoothness before rehabilitation

All of the rehabilitation strategies were applied before pavements reached the smoothness zero-remaining service life threshold of 300 inches per mile.

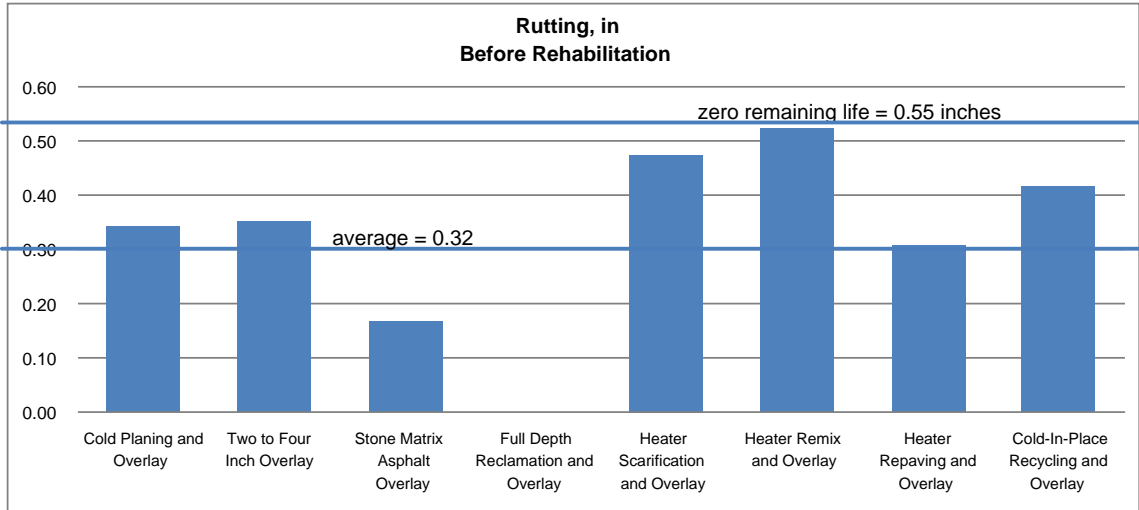


Figure 105 – Average Rutting Before Rehabilitation

All of the rehabilitation strategies were applied before pavements reached the rutting zero-remaining service life threshold of 0.55 inch. However, the heater remix and overlay strategy nearly reached the zero-remaining service life threshold with an average rut depth of 0.52 inch.

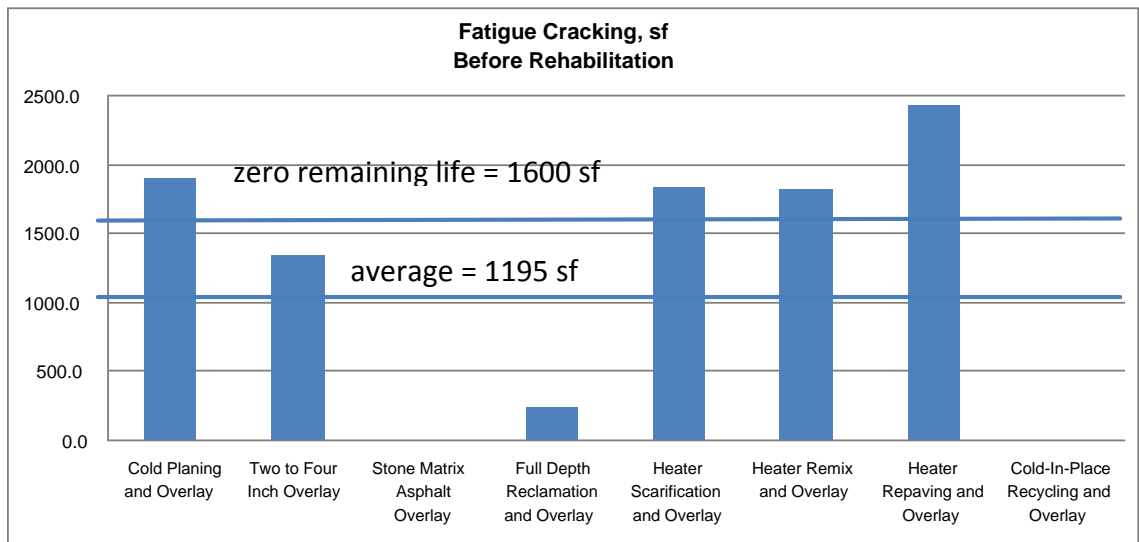


Figure 106 – Average Fatigue Cracking Before Rehabilitation

Four strategies were applied after the pavements reached the zero-remaining service life threshold of 1600 square feet of fatigue cracking. These were cold planing and overlay, heater scarification and overlay, heater remix and overlay, and heater repaving and

overlay, at 1908, 1834, 1817, and 2429 square feet, respectively. This level of distress represents approximately 19, 15, 14, and 52 percent in excess, respectively, of the zero-remaining service life distress level of 1600 square feet of fatigue cracking.

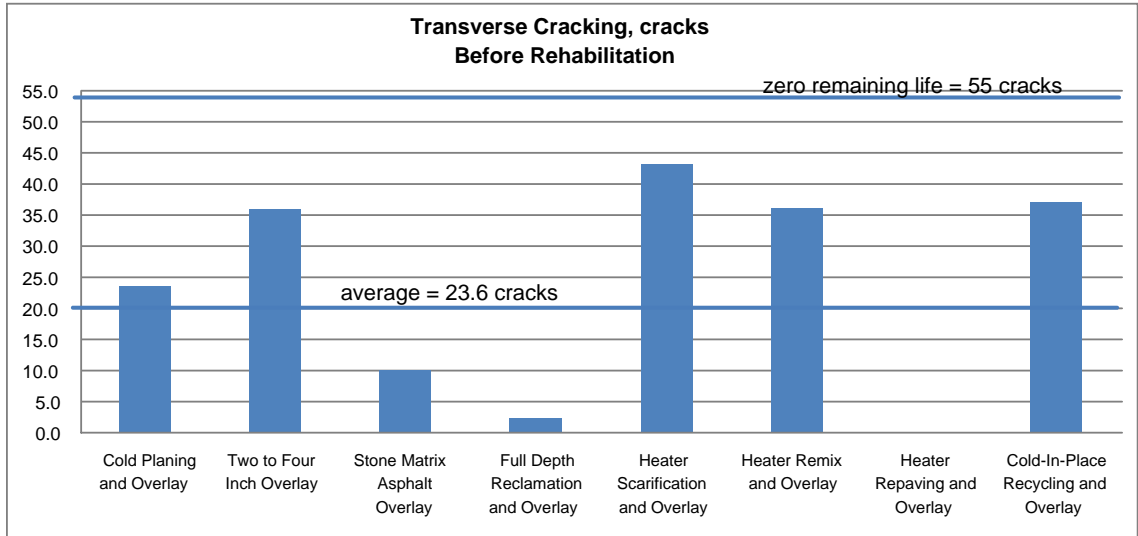


Figure 107 – Average Transverse Cracking Before Rehabilitation

All of the rehabilitation strategies were applied before pavements reached the transverse cracking zero-remaining service life threshold of 55 cracks per 0.10 mile.

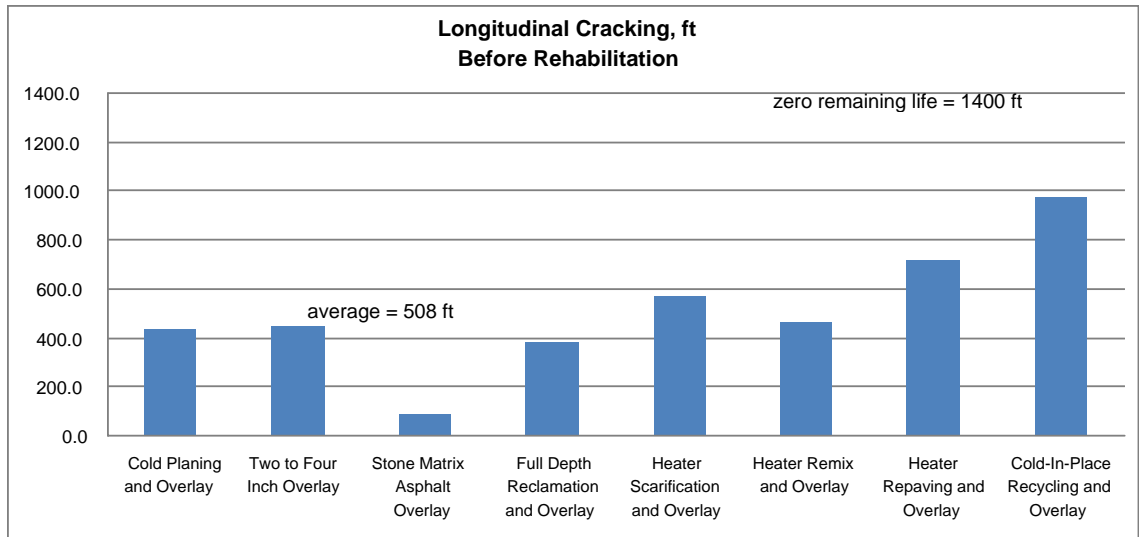


Figure 108 – Average Longitudinal Cracking Before Rehabilitation

All of the rehabilitation strategies were applied before pavements reached the smoothness zero-remaining service life threshold of 1400 feet.

6.0 CONCLUSIONS

1. The pavement management database is a useful tool for analyzing the performance of various rehabilitation strategies with respect to the rate at which various types of pavement distress reoccur.
2. There was not enough data in the database to evaluate each rehabilitation strategy for each independent variable. However, when all of the data was analyzed the following results were observed: cold planing and overlay tends to outperform the average of all rehabilitation methods and two to four-inch overlays are a close second with respect to the rate of change of distress with time. Heater scarification and overlay tends to perform poorer than the average strategy with respect to the rate of change of distress with time.
3. Pavement condition tended to be below the Zero-Remaining Service Life Threshold (ZRS�) for all performance indicators except fatigue cracking. The

condition of the pavements where cold planing and heater scarification were utilized exceeded the ZRSL threshold.

4. Rehabilitation would have been warranted earlier in the life of the pavements that reached ZRSL at the time of rehabilitation. As a result, the expected life of the rehabilitation strategies utilized on these pavements may have been shorter than could be expected had rehabilitation been done before distress reached this high level.
5. Although a linear regression was used successfully to compare the rates of change of distress through time for the first six years of pavement service life for this research, it is likely a more complex model would be needed to predict performance beyond this time.

7.0 FUTURE RESEARCH

A more complete analysis of CDOT's pavement management database is needed to ensure a sample size big enough for all criteria to be represented adequately. Some rehabilitation techniques did not have adequate amounts of data or the data that was included with those techniques did not meet the predetermined criterion.

Data needs to be continually updated as CDOT collects pavement distress data. A program or process that can automatically select data from the Access database is needed so the entire highway network can be analyzed annually.

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APPENDIX A

INSTRUCTIONS FOR CONVERTING ORIGINAL PMS ACCESS DATABASE DATA TO EXCEL

A detailed procedure for replication and continuation of this project is required for the Colorado Department of Transportation to update its records. This is required in order to help improve the efficiency of the current pavement rehabilitation strategies around the state. Steps to replicate study and add to the data pool are listed below and described in more detail later.

1. Retrieve highway data from database.
2. Copy information into excel spreadsheet and organize by year and highway segment.
3. Separate highway segments into directions.
4. Calculate a moving average of every 0.5 miles.
5. Calculate maximum moving average for each direction and segment.
6. Organize data into spreadsheet using maximum moving average by year and highway.
7. Determine what “year 0” is.
8. Separate data by distresses within each rehabilitation strategy.
9. Organize by year.
10. Calculate slope using slope function.
11. Calculate R^2 using coefficient of determination function.
12. Manually sift through data to determine what segments meet criteria.
13. Calculate the average distress per year using the average function.
14. Calculate the slope from year to year using the slope function.
15. Calculate the cumulative slope for all rehabilitation strategies and distresses.
16. Using the “linest” function in Excel, calculate the coefficient of determination value for each line created.
17. Create table that shows the amount of distress each year based on slope for each criteria.
18. Calculate the average number of samples each year for each rehabilitation strategy by distress.
19. Graphically show cumulative slope for each rehabilitation strategy by distress and criteria.
20. Calculate the slope for each line.
21. Analyze data as needed.

CDOT keeps a detailed record of highway conditions organized by highway number and milepost. This pavement management system is organized and updated in a Microsoft Access database. The first step of the research is to search the database for the predetermined sections of highways. These sections of highways need to be highlighted and copied. The data is then pasted into a Microsoft Excel spreadsheet and organized tabularly by year and within each tab organized by highway segments. See Figure 109 for example.

The screenshot shows an Excel spreadsheet with the following structure:

- Section 1 (070A, 070B, 070C):** Contains detailed data for highway segments. Columns include: HUY, DIR, DRP, EMP, PAV, PTP, HSC, DIM, ZONE, F, RUT, FATIGUE, TRANSMISS, LONG CORNER, FEE, RUT, FATS, EX, LOWS, EX, TRANSP, FAT, RUT, FATS, EX, LOWS, EX, TRANSP.
- Section 2 (070A, 070B, 070C):** Contains summary statistics for each segment, including '070A, 1', '070A, 2', '070B, 1', '070B, 2', '070C, 1', '070C, 2'.
- Section 3 (070A, 070B, 070C):** Contains data organized by year (1999-2006) for each segment.

Red annotations in the image highlight:

- Max moving averages:** Points to the summary statistics columns.
- Direction of travel:** Points to the 'DIR' column.
- Highway Segment:** Points to the 'HUY' column.
- Moving average calculations:** Points to the summary statistics columns.
- Tabs by year:** Points to the year-based data columns.

Figure 109 Example highway segment spreadsheet

After data is transferred into the Excel file, sort highways by direction so that a moving average can be calculated for each highway and each direction. To sort data use

the “sort” function in Excel found under the data drop down tool menu. Select the data and then sort it by direction in ascending order.

After all data is sorted, use the “Average” function in Excel to calculate a moving average of every 0.5 mile for both directions of traffic. After calculating the moving average for all highway segments, the maximum moving average is found using the “max” function in Excel. The maximum moving average is calculated for both directions of travel and for each highway segment.

A separate worksheet is used to organize data by year and maximum moving average shown in Figure 110. Data is then separated by year, region, and highway segment. Link worksheets to ensure that changes are reflected on all worksheets.

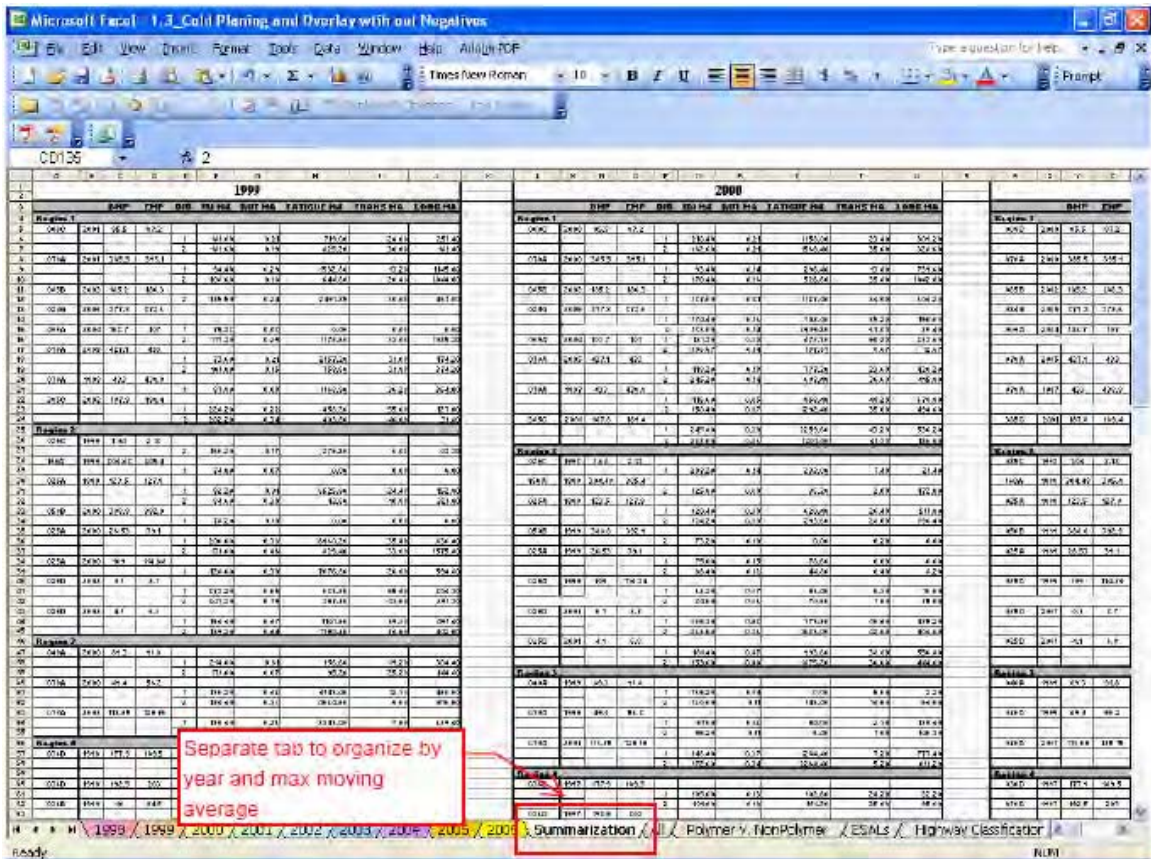


Figure 110 Example summarization spreadsheet

Organize data into the different variables starting with year zero and ending with year six. Using historical information, determine which year was the last year the section of highway received rehabilitation. That year will be represented as year zero. Separate sorted data by distresses and then calculate the slope for all highway sections using the “slope” function within Excel. The coefficient of determination is also calculated using the “rsq” (r squared) function within Excel.

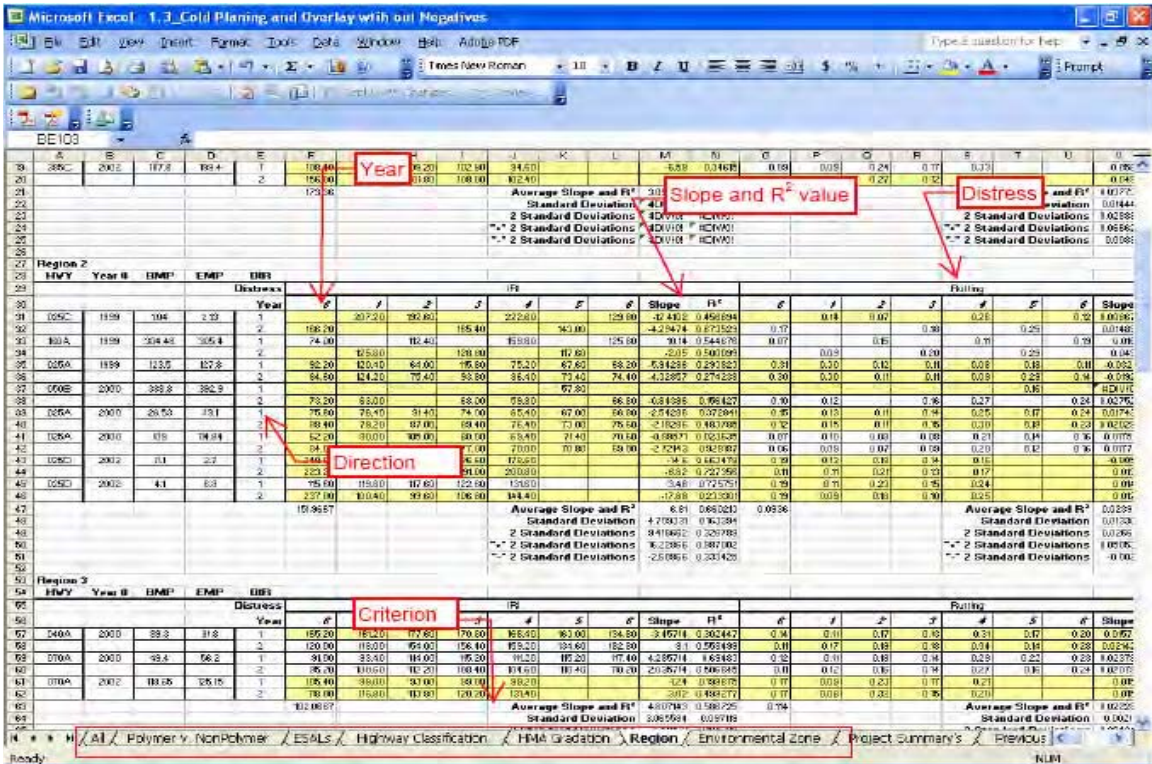


Figure 111 Example criterion spreadsheet

Determine which highways meet the 0.5 R^2 value and have a positive slope. With this information calculate what the average distress for the highway segments for each year using the average function. The slope for each year is then calculated from this information. The n,Average, which is the average number of highway segments in each year, is also calculated utilizing the count function in Excel.

Calculate the coefficient of determination using the “linest” function in Excel for all the data used to determine how accurate the calculated slopes are. This information is presented in a table that shows the cumulative slope for each year, the overall slope of the line, the coefficient of determination, and the n,Average. The cumulative slope is then shown graphically. Data can then be analyzed by rehabilitation strategy.