VALUE ENGINEERING STUDY OF CRACK AND JOINT SEALING

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The two chapter report summarizes the results of a cooperative Value Engineering study of Crack and Joint Sealing. The study was conducted by the states of Delaware, Georgia, Montana, Tennessee, and Utah. The report should be of interest to State and local maintenance engineers concerned with the proper methods of sealing cracks and joints in pavements.

Research, development and implementation for improving maintenance operations is included in the Federally Coordinated Program of Highway Research and Development in Category 3, "Highway Operations."

R. J. Betsold
Director, Office of Implementation

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This report summarizes the results of a cooperative value engineering study of crack and joint sealing. The objective of the study was to optimize the expenditure of maintenance resources through an in-depth study of crack and joint sealing materials and placement techniques.

The report includes recommendations on crack preparation, materials, and application for sealing both asphalt and Portland cement concrete pavements. The general consensus of the States involved in this study was that sealing cracks will significantly increase pavement life.
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Value Engineering Study  
Crack and Joint Sealing  

BACKGROUND  

A study by the Transportation Research Board (TRB) under a contract with the Federal Highway Administration (FHWA) identified a number of highway maintenance research needs. One topic recommended for study was optimizing the expenditure of maintenance resources. Value Engineering (VE) is a method of analysis which can be used for this purpose. The FHWA is sponsoring a series of State-conducted maintenance research studies to promote the optimization of maintenance resources and to demonstrate VE techniques. This report summarizes one such project.

Value Engineering techniques consist of an engineering team approach in which all basic functions of a process are defined, analyzed, and assigned values according to their worth in obtaining the end product. The low value/high cost functions are further analyzed to see if they could feasibly be done less expensively by alternate means or, in some cases, completely eliminated.

This report summarizes the result of a cooperative Value Engineering Study of crack and joint sealing undertaken by the State Departments of Transportation of Delaware, Georgia, Montana, Tennessee, and Utah under the sponsorship of the FHWA, Office of Implementation. The objective of this joint study was to optimize the expenditures of maintenance resources through an in-depth study of crack and joint sealing materials and placement techniques.

PROJECT OBJECTIVE  

The objective of this joint effort is to optimize the expenditure of maintenance resources through an in-depth study on sealing cracks and joints in both asphalt concrete pavements and Portland cement concrete pavements as one major activity of highway maintenance.
STUDY APPROACH

As a VE study topic has been chosen, the next step is to identify the essential functions of the item or service being studied. Then several different ways of furnishing the item or service are systematically evaluated to determine how unit cost might be reduced without sacrificing any essential functions.

Value engineering uses a team-oriented approach to problem solving, so an early step in this project was to set a VE team within the transportation agency of each of the five participating States. Each team made a VE study of the crack and joint sealing activities used in its State. All five teams and FHWA were represented at a series of five coordination meetings. One such meeting was held in each of the participating States. These meetings facilitated information exchange through personal contacts and also helped insure that all teams followed a common workplan.

The coordination meetings attended by study participants at intervals during the project yielded significant benefits beyond their immediate function of maintaining unity among the five State investigations. The sessions provided many chances for the team members to observe and evaluate equipment and methods being used by others.

The need for sealing was a primary concern of the group. From their experiences, the team members felt that sealing both asphalt and Portland cement concrete pavements would significantly increase pavement life. There are several reports documenting the benefits of sealing pavements, including the National Cooperative Highway Research Program Synthesis Highway Practice No. 98 titled "Resealing Joints and Cracks in Rigid Flexible Pavements." The report surveys both State and Federal concerns concerning the need for sealing. The report states:
The report "Transverse Cracking of Asphalt Pavements" (FHWA-TJ-82-1) graphically depicts the results of an unsealed crack. Figure 1.

Figure 1. Transverse cracking of asphalt pavement

The time constraints of this study did not allow use to evaluate the benefits of sealing versus not sealing. The study numbers fell if sealing is necessary and that the above referenced reports, and several other well-documented studies, have properly addressed the sealing cracks and joints as a preventative maintenance activity.
As the study progressed, more and more time was spent on value engineering the AC crack sealing procedures. The Georgia DOT has prepared several well documented studies on the most effective techniques for sealing PCC cracks and joints. The results were supported by the work and experiences of the other State teams. The study portion on PCC crack and joint sealing will, therefore, reflect information from these studies!
FINDINGS AND RECOMMENDATIONS

The major findings and recommendations are briefly stated below. Details can be found in the "Discussion" section of the report.

Recommendations for Asphalt Pavement Sealing

1. A crack analysis is necessary to determine if crack sealing is cost effective.

2. Clean and fill all cracks 1/4 inch and larger. (Rule of Thumb: If a pencil will stand up in the crack, it needs to be sealed.)

3. Use a quality product to seal cracks.

4. Routing as it is presently performed is not generally recommended.

5. Cleanliness and dryness is an important factor when sealing AC pavements.

6. Follow the manufacturers' recommendations for handling and placing sealants.

Recommendations for Sealing Portland Cement Concrete (PCC) Pavements

1. Cleanliness and dryness of the crack or joint is critical.

2. Resawing is desirable to obtain the proper size joint opening.

3. Use a properly sized backer rod.

4. Establish a testing program to evaluate sealants to insure product.
...is with any repair or maintenance activity, an analysis is made to determine the type and scope of work. A crack seal can only be effective as long as the sealant prevents the entrance of water. It cannot be effective when the pavement integrity has failed. Therefore, pavements with extensive cracking should not be crack sealed. In pavement analysis may instead recommend a chip seal, slurry seal, or an overlay especially as the cost of sealing approaches these other surface treatments.1)

The use of photographs as guides to determine the percent cracking of a pavement is recommended. This will provide uniformity in ratings for rehabilitation. The study teams recommended using the photographs such as those used by the Arizona DOT. A copy of the material is included in the appendix.

2. Clean and Fill All Cracks 1/4 Inch and Larger

Specific recommendations were consistent among the States even with the variety of climatic conditions. The most notable exception concerns the size, type, and extent of cracking to be filled in asphalt pavements. The range varied from a minimum of 1/2 inch to filling all cracks. Georgia's policy is to fill all cracks. This requires the routing of those cracks which are too small to allow sealant material to fill the void. The key is that all cracks must be filled to prohibit water from entering the subgrade. Georgia will continue this policy as long as they have the manpower and money available.
Crack "filling" had been thought of as a make-work activity. The crews would go out and fill the same cracks with asphalt year after year.

Crack "sealing" is different in that the crack is not only filled but sealed to keep out water and other foreign matter. To obtain a good seal, it is important to use a quality product. Although material costs for proprietary sealing materials are initially higher than for plain asphalt, the study teams felt that the life cycle costs of these products is lower because of their longer life. Most of the States had already been using crumb rubber and asphalt for sealing and were very pleased with the performance. The expected life of the seal is 3 to 5 years. However, not all rubber asphalt sealants perform alike. Each should be laboratory and field tested before widespread applications are made.

A list of desirable properties that crack sealants should have was developed. The list is not all inclusive, but provides a guide for what must be considered when selecting a material.

- **Sealing Properties:**
  - Ability to penetrate into the crack at low ambient air temperatures
  - Irreversibility at low temperatures
Material at high service temperatures
Adherent to asphaltic concrete
Linear failure resistance
Resilience or elasticity
Low temperature elongation at high rate of strain
Good ductility under conditions of low temperature
Reasonable cure time (shall cure immediately upon cooling to a sufficient viscosity to prevent tracking by vehicles)
Weathering resistance
Workability - the material should pour readily over its specified application temperatures for the entire ambient temperature range recommended by the manufacturer.

4. Routing as Presently Performed Is Not Recommended

Routing is a costly, time-consuming portion of crack sealing. When routing is not required, savings of 15 to 30 percent can be realized.

The pounding produced by routing may cause a fracture (Figure 2) or weakening of the sidewall and a subsequent sealant failure. Irregular crack patterns are difficult to follow and if the router misses a crack the result is a second crack which must also be filled (Figure 3).
Figure 2. Fracture of pavement caused by rutting.

Figure 3. Wear on pavement surface.
Cleaning is an Important Factor when Sealing AC Pavement

When sealing PCC pavements, cleanliness is often overlooked when sealing asphalt pavements. The study included several methods of cleaning cracks: wire brushing, compressed air, and a flame air blast such as the Prismo Wand.

The wire brush is a relatively cost effective method for removing dirt and debris from large shallow cracks. Brushing did not remove dust which can inhibit the bond between the crack wall and the sealant.

Using compressed air is a good method for removing dust, sand, and other foreign matter from the crack and will usually provide a clean face for bonding (Figure 4). The compressor hose should be checked for oil and water by passing a tissue through the air stream and looking for stains. The compressor must have a trap to collect water and keep it out of the lines. It is also important to protect the workers with ear and eye protection when working with high pressure air.

Combining high pressure with a flame seems to hold the most promise (Figure 3). This equipment delivers a high-velocity, heated air stream (3000 feet per second at 3000 °F) which dries and cleans the crack. In addition, the asphalt surface is heated and the asphalt binder softened to aid the bonding of the sealant. The Prismo Hot Compressed Air (HCA) Lance was tested for this purpose. The States reported that when properly used (i.e., travel at a walk so as not to burn the asphalt) the HCA Lance is faster than the plain compressed air. It is thought that the HCA Lance will also burn any organic matter in the crack and will therefore inhibit any regrowth.

The back pack blowers were evaluated; however, they do not have sufficient pressure to adequately clean the crack and are not recommended (Figure 6).
Figure 4. Crack-cleaning with compressed air.

Figure 6. Scoop registration.
Follow the Manufacturer's Recommendations for Handling and Placing Sealants

The States found that with rubber asphalt products it is very important to follow the manufacturer's recommended specifications for handling and placing of the sealants. Following these specifications increases the quality of the seal and the pot life of the material.

One exception to the recommendation concerned the percent rubber in the sealant. Rubber content is critical. Eighteen percent ±1 percent by weight appears to provide a good seal, and will substantially reduce material warm-up time and reduce equipment clogging when compared to higher manufacturer's recommended percentages.
A problem in temperature monitoring was discovered by Utah DOT when
they were testing all of its units for accuracy on the temperature
probes. The most dramatic variations occurred in one particular unit.
This unit incorporates only two temperature gages, one in the re-
circulation system which measures material temperature; the other in
the heating chamber which measures the oil temperature. This unit was
in error by \pm 7\degree F when tested with an independent ASTM thermometer.

When first tested, the readings were 350 \degree F for the circulator gage and
286 \degree F in the pot using the ASTM thermometer. After heating the
material 1 hour, the circulator gage read 360 \degree F while the pot tempera-
ture rose to 430 \degree F. Such high temperatures for rubber asphalt sealants
will significantly shorten the pot life of the material. Utah believes
that the probes used may be bending because of the high fluid pres-
sures. It will now be specifying a better temperature gage and probe
along with a protective sleeve to keep the sealant or heating oils from
bending the probes. (1)

The Utah DOT also noted that on some of their equipment the auto-
matically controlled burner shut-offs were being manually adjusted in
the field. It is reported that the electronic circuitry was being
bypassed in order to reach pour temperatures. This bypassing of the
electronic circuitry was in part due to the 450 \degree F maximum control
temperature and the undersized burners which were incorrectly speci-
fied. Bypassing of controls has also occurred on equipment where the
gages were non-functional.

The degree of the safety problem was not fully defined. Additional
product information on the fire potential and explosive characteristics
of heat transfer oils needs to be obtained. Recommendations for safe-
operation, until further information is available, are as follows.
1. Be instructed in the calibration of heat transfer oil gages on assigned equipment.

2. Be instructed in the calibration of heat transfer oil gages on assigned equipment.

3. Be instructed in the calibration of heat transfer oil gages on assigned equipment.

4. Be notified that under no circumstances will crumb rubber mill be operated with the heat transfer oil boiling.

5. Be instructed that under no circumstances will this equipment be operated with heating oil temperatures in excess of 300°F on a continuous basis.

6. Be notified that unless the manufacturer's suggested range can be maintained material should not be placed.

7. Be instructed to inspect the interior of the product tank for buildup of sealant material on the tank wall. If a cake is present the machine shall either be scraped clean or sent to shop for cleaning.

8. If the product tank is free of residue it should be cleaned with solvent at frequent-enough intervals to prevent residue from developing.

Each shop foreman with an assigned crumb rubber machine should see that heat transfer oil gages on assigned equipment are operational and properly calibrated particularly in the 450° to 550° F operating range.
Maintenance shop personnel should be sure to specify burner wattage and hot mix plant temperature. This will insure placement of the material at a high enough temperature. It should also eliminate electronic circuitry-bypassing by field personnel.

Another problem concerning shoving on new overlays over recently sealed roads was brought up at the first meeting by Montana. It presented a series of slides which showed a recently crack-filled road being overlayed where shoving occurred during the rolling operation (Figures 7-11). The result was a series of bumps and a rough ride over the new pavement. The problem was eased by reducing the hot plant mix temperature and decreasing the initial rolling effort. (2) Delaware took cores in several areas on one of its overlays. From the core samples, it appeared that the sealant was heated by the hot asphalt concrete and forced up into the new material during the rolling operation.

These rolling problems occurred on laydowns placed either early or late in the paving season. Overlays effected were two (2) inches or less in thickness. Problems involved tearing, shoving, and/or washboarding of the overlay during passage of the roller over a recently sealed transverse thermal crack.

Sealants involved were sealed during cool weather (thermal cracks were partially open). Weather remained cool between sealant application and overlay. Filled cracks remained open). Maximum period between sealing and laydown was 7 to 9 months; typically sealant was applied within a month or less of the paver operation.

When the overlay was placed there was apparently sufficient heat transfer to the underlying pavement to cause the pavement to expand. This expansion forced this sealant between the overlay and the pavement. When the overlay was run, this bulge of material was apparently squeezed into the interface separating the overlay from the pavement. The resultant interlayer of sealant was subjected to the force between the overlay and the pavement which resulted in shoving, tearing, and/or washboarding of the overlay. These failures occurred immediately above or just past the transverse crack.
Figure 7. Sealed crack before overlay

Figure 8. First lift.

Figure 9. Cracks appear after rolling.
Figure 10. Cracking appears in finished pavement.

Figure 11. View of cracking along road.
The study teams looked at optimum crew sizes. At present, the best staffing plan would require six persons using a train (Figures 12 and 13) with a compressor and crack sealing machine working together; if traffic control is required, one or two additional persons are needed. The crew can be assigned as follows:

One slowing cracks; one truck operator; one placing material; two squeegee operators and one feeding block, placing cones, and operating a second train (Figure 14). A recommendation was made to use wands with a shoe already attached for striking off the sealant (Figure 15). This would eliminate the need for one of the squeegee operators. Another recommendation was to have crew members come in a few hours early to heat the material so that crews begin on schedule. (2)
Figure 14. Applicator and squeegee in close operation.

Figure 15. Applicator wand with squeegee mates squeegee.
The study shows the need for sealing shoulders or shoulders of the subgrade. The States currently sealing shoulders and the travel lanes in the same manner.

The following safety precautions are recommended:

1. Use ear and eye protection when using high pressure equipment.

2. In case of an accident, have cold water on hand to cool hot material on exposed area.

3. Use gloves and long sleeved clothing when working around the sealing machine.

4. Use 30-pound blocks instead of 60-pound blocks for charging rubber asphalt sealing machines. This speeds up melting, is easier to handle, and reduces the splash when loading.

5. The Delaware DOT has devised an attachment which effectively eliminates splashing when loading blocks of sealant into the mixing chamber of rubber asphalt sealing machines (Figure 16).
EXTENSION BOX FOR CRAFCO SEALER

1. BOX MADE FROM 1/8" STEEL PLATE AND 1" ANGLE

2. UNIT FITS INSIDE TOP OF CRAFCO UNIT

3. UNIT CUSTOM MADE TO FIT UNIT

FIGURE 16. EXTENSION BOX FOR CRAFCO SEALER
Crack sealing technology has been evolving at a rapid rate. New materials, some with critically different properties, are being developed. Since the start of the study new materials have come along which were not evaluated and new equipment developed such as the Hot Compressed Air Lance which only received preliminary testing by the States. It is therefore recommended that States develop an ongoing testing program to evaluate new materials and techniques. The program results should be made available statewide on all tested materials. City and county highway departments would also benefit from tests conducted under the local climatic conditions by requesting information from their State highway department.

One example of such a program is Utah's research on crack sealing methods and materials for flexible pavements. Test sites have been established to evaluate sealant materials (provided and placed by the suppliers) in both routed and unrouted cracks under both severe and moderate climatic conditions. The State is also evaluating materials placed in an unrouted band-aid configuration (Figure 17) and is working on developing a method of shallow (1/4 inch) routing for band-aid placement (Figure 18). A final report is expected by mid-1984.

DISCUSSION - PORTLAND CEMENT CONCRETE PAVEMENT SEALING

Cleanliness and Dryness of the Crack or Joint is Critical

When working with a sealant, the sides of all cracks and joints must be clean and dry. Any moisture or residue materials will inhibit bonding. The most common cleaning deficiency for resealing work is old sealant left on joint faces. The following cleaning methods have been successfully used:

a. Sandblasting (Figure 19)

Sawing residue should not be permitted to dry and harden on joint faces; however, if it does dry, it can be readily removed by sandblasting. Hot-poured rubber asphalt left on joint faces is very difficult to remove even by sandblast blasting. Often the sand will cut too
Figure 17. Unrouted uni-aid seal.

Figure 18. Bond-aid seal.
concrete adjacent to the rubber asphalt before the old sealant is removed. Some old sealant can be removed by sandblasting if it is in a deteriorated, oxidized condition but this is usually a very slow process. Sometimes oil will be splashed on joint faces that cannot be easily removed with high pressure air alone.

b. Compressed air (Figure 20)

Always check for oil. The air compressor should have a trap capable of removing excess moisture and oil. Oil and moisture when present can be detected by simply passing a piece of clean tissue through the air jet. Air compressors in poor condition sometimes produce air containing oil. This inhibits the ability of the sealant to adhere. Excessive moisture is also undesirable.

An air jet, when directed into a wet joint, will usually splash mud on joint faces and result in a worse condition than if it were not used. The joints can be blown completely dry after which the dry contaminant is readily removed with compressed air.

c. Water jet (Figure 21)

Joints freshly sawed or joints resawed to remove old sealant can usually be cleaned with a well-directed water jet. Unless an excess of water is used, sawing residue suspended in the water will redeposit on joint faces. A well-directed jet of water can be used to force sawing residue and old sealant away from the joints so that it does not return.

d. Wire brushing (Figure 22)

Wire brushes used in conjunction with compressed air are the most effective method of cleaning joints. Joints cleaned in this manner are usually dry and can be sealed immediately after cleaning. When joints cut the minimum width, some wire brushes will not go into the joint. However, brushes are available that will do an effective job. These brushes have bristles that are long enough to be concentrated in
Figure 19. Sandblasting.

Figure 20. Pressed air.
Figure 21. Water jet.

Figure 22. Wire brush.
a. Blade width. Blades may be ganged together to achieve the necessary width. This is usually more economical than using expensive wide blades.

b. Blade diameter. Use smaller diameter saw blades for resawing joints. The blade diameter influences the following: (1) Horsepower of the saw and (2) the cost of sawing. Larger diameter blades cost more. Generally, the blade diameter should be no more than necessary to cut the required depth.

c. The water supply must be adequate to cool blades and a jet of water should be directed to both sides of the blade.

d. Sawing RPM is determined by blade diameter; normally surface speed should be 9,000-10,000 ft/min.

e. Maneuverability of the saw. The more maneuverable saws can more accurately follow initial cut or old joint centerlines.

f. Cutting pressure, which is a function of forward travel speed, should be operated so that the blade does not try to ride out of joint. The crowding of a new blade may cause the saw to lead to left or right. Wiping or dishing of blades may also result.

g. Orientation of saw, such as change of position at shoulders, change of direction, etc., can cause a blade to become out of alignment.

h. Accurate operation of the saw is essential. The minimum width is desirable. To follow the joint accurately enough to cut 1/16 inch or less each face requires very accurate sawing. Small saws have relatively a maneuverability.
1. Wheel wear. Uneven wearing of drive wheels will cause a saw to be left or right and control is difficult.

3. Use a Properly Sized Backer Rod

The sealant should not be installed as a rectangular or square section, but made to conform to the shape of a backer rod with a parabolic or deformed circular shape and finished on top with a concave surface. This has the effect of providing a greater bond surface than a rectangular sealant section (Figure 24). The concave free area also provides a longer outer fiber which has the effect of lower stress in the outer fiber when the sealant is extended. This shaping is obtained by using a backup material (backer rod). The purpose of the backer rod is only to (1) support the sealant until it cures, (2) provide a means to control the depth of the sealant section, and (3) provide a surface to which the sealant will bond.

Closed cell polyethylene foam backer rod is used almost exclusively when backup material is required for cold applied polymeric sealants (Figure 25). A rule of thumb for the size of the backer rod is to use material with a diameter 1/8 inch greater than the saw cut width. A backer rod too small will not remain in position until the seal cures, but will curl out of the joint, fall to the bottom of the joint, or be forced down by the sealant as it is extruded into the joint. A backer rod which is too large will be evidenced by the following: (1) it will rupture during installation, (2) it will be more difficult to position at the proper depth and frayed portions of rod will be found protruding through the sealant section.

A roller with a flange slightly narrower than the narrowest joint is used (Figure 26). The depth of the flange must be greater than the recess desired plus the sealant depth desired because the backup is very resilient and will rebound. It is important that the depth of
Figure 23. Resawing a joint.

Figure 24. Cross-section of a joint.
Figure 25. Placing theacker rod

Figure 26. Hocker rod placing too1
As discussed in the Asphalt Pavement Sealing section of the report, materials are continuously being developed and improved. More cost effective sealants and placement methods for both AC and PCC pavements should be available in the near future. Therefore, a consistent and ongoing research and testing program should be developed by every State. The program should test not only the new or improved materials but also any revised placement techniques. The results of all tests and demonstrations should be made available statewide regardless of whether the material is a success or failure.

The study teams identified a list of 15 materials for possible evaluation. From the list, four materials were chosen for additional study: silicon rubber asphalts, polyvinyl chlorides (PVC), and polymerized asphalts. Based on the experiences of the States, these materials promised to be cost effective for sealing pavements.

The States felt that a long lasting, watertight seal was the most critical factor for selecting a sealant material. While all of the sealants filled the void, and to some extent sealed the crack or joint, not all sealants were able to give a consistently watertight seal.

Current research indicates that low modulus silicones will provide an effective seal for over 8 years, while rubber asphalts will normally last 3-5 years. The PVC and polymerized asphalts tested received reports on their expected life and effectiveness in sealing out water. The long life provided by silicone sealants is especially important to maintenance forces who must face high-speed traffic when returning to service.
highways. If silicone is used, a low modulus (i.e., readily stretches) is needed to accommodate the relatively large movements of some slabs.

**Observations**

The nozzle should be such that it can (1) fit into the joint, (2) have a flange that will ride on top of the slab, and (3) protrude into the joint enough to insure that sealant is forced to the bottom of the joint but not far enough to displace the backup material or to cause the force of the sealant to displace the backup rod. The rate of speed that the nozzle is passed through the joint should be constant.

It is important to control the depth of the sealant. This can be done by plugging the joints (Figure 27). This is routinely done to evaluate contract work. A range in thickness of 1/2 inch to 1/4 inch can be permitted. The plugged joint is resealed with a caulking gun. One of the positive aspects of silicone sealant is that it can be easily patched. Silicone sealant bonds readily to cured silicone with a freshly cut surface. Hand cartridges can be used to touch up trouble spots or to reseal inspection plugs.

Recessing the sealant cannot be overemphasized especially when grinding is anticipated. The trend has been to recess sealant more and more. No problems were found because of deep recess but immediate failure is caused by no recess. Deep recessing does increase the difficulty of installation and strike off and more variation in depth is found when deep recesses are required.

When installing silicone, the sealant must be pumped down into the joint such that the material contacts with the joint faces. To insure good contact with the joint face a tooling operation is required (Figure 28).
Sealant extruded into a joint will not adhere properly.
Figure 27. Testing depth of sealant by cutting out a plug.

Figure 28. Tooling operation.
References


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Salt Lake City, Utah 84119

Dear Sir:

Enclosed you will find a set of pictures that ADOT uses as standard percent cracking photos. In addition, an explanation of how to use the photos and lineal feet of cracking measurements. We inventory a 1000 square foot area in the travel lane at each milepost once a year for percent patching and cracking. This information is used along with ride roughness to determine when and where overlays are needed. Percent cracking values along with dynaflect deflection help determine what type of overlay special treatment (asphalt rubber or surface recycling) are needed as shown on the decision tree attachment. If you have any questions about this process please call.

Sincerely yours,

GEORGE B. WAY
Pavement Management Engineer

GBW/1c
Attachment
TO:   ROWAN PETERS
       ASSISTANT ENGINEER OF MATERIALS

FROM:    GEORGE WAY
       SENIOR MATERIALS RESEARCH ENGINEER
                (ACTING)

RE:   GUIDELINE FOR DETERMINATION OF PERCENT
       CRACKING OR LINEAL FEET OF CRACKING

In the past, guidelines for determination of cracking have been cumbersome to use. In addition, once in use, output from crack surveys has been difficult to quantify for purposes of pavement evaluation and subsequent rehabilitation design. As such, a new system of analyzing cracking is recommended. This system is based on work done on the Minnetonka project.

During the project hundreds of photos were taken and the percent cracking determined for each photo. Photos were placed in order of increasing percent cracking. Free hand drawings representing a cracked section of highway 20 feet wide by 50 feet long were drawn. These drawings are attached. From the drawings lineal feet of cracking was determined. Results of this work were plotted as percent cracking versus lineal feet of cracking. From this plot a best fit curve was determined, (Figure 1). Generally 1 percent cracking equals 20 lineal feet of cracking.

In addition to the drawings, you will find attached a series of photos depicting increasing cracking.

The recommended procedure for determining percent cracking or lineal feet of cracking would be the following:

Locate a 50' x 20' section of roadway, preferably at a milepost. From the photos and drawings, match the percent cracking. For percentages less than 10, round to nearest 1 percent. For cracking greater than 10 percent, round to the nearest 5 percent.

George B. Way

Attachments