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# CHAPTER 10
## PREVENTIVE MAINTENANCE

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10.1 INTRODUCTION

This chapter is to be used in conjunction with Chapter 2 Evaluation of Existing Pavements (which includes Volume 1 of the Pavement Rehabilitation Manual as Appendix 2A), to select preventive maintenance alternatives and determine the most cost-effective treatment to prevent pavement distress and increase pavement service life. This chapter does not compare one treatment to another; it provides information on each treatment type, so a decision to use a given treatment, or combination of treatments, can be made on an informed basis. The requirements in Chapter 3 of this manual, Section 3.3 - Pavement Treatment and Type Selection Process, must be used when considering the treatments in this chapter. Refer to Chapter 3 of this manual for additional requirements for preventive maintenance projects progressed under Element Specific, 1R, or SAFETAP.

Note: Due to the timeliness of application required for preventive maintenance to be effective, Regional Designers should contact the Regional Materials Engineer to discuss the proposed schedule for the project and the appropriateness of the treatment. The Regional Materials Engineer can also assist in providing the latest specification item numbers and other design information.

Life-cycle-cost analysis is not required to choose between the treatments described in this chapter. Preventive maintenance is part of the life-cycle of the pavement structure and all associated costs should be considered when determining the life-cycle-cost of pavement rehabilitation options. This chapter should be used as an aid in selecting the most appropriate, cost-effective treatment. Guidance for construction inspection can be found in other manuals. A list of suggested reference materials is given in the Appendix.

The estimated service lives included in this chapter are based on the assumption that the treatment is being applied to pavement in good condition with only low severity distress. The service life will decrease, as the level of pavement distress at the time of treatment application increases. Contact the Regional Pavement Engineer or Materials Engineer for assistance in determining the expected service life of specific projects.

Note: The service lives given in this chapter are for use on NYSDOT projects. The level of pavement distress constituting the end of a treatment’s service life will vary between purchasing agencies. On low volume facilities, the service lives of these treatments may be considerably longer than the estimates given in this chapter.

This chapter does not provide estimated costs for any included treatments. Because many of these treatments are new, their costs are continually declining relative to more traditional treatments. A good estimate of cost can be determined by examining the Office of General Services contract award notices issued each year.
10.1.1 **Definition of Preventive Maintenance**

Preventive maintenance is any planned activity performed in advance of a critical need for repair or accumulated deterioration so as to avoid such occurrences and reduce or arrest the rate of future deterioration. The activities may correct minor defects as a secondary benefit. Preventive maintenance activities extend a pavement service life, without significantly improving the pavement’s structural capacity. The primary intent of a preventive maintenance treatment is not to correct specific pavement distress, but to delay the development of distress. To be successful, preventive maintenance must be undertaken when little distress is evident. "To be cost-effective, pavement preventive maintenance treatments should be applied before most engineers, or project decision makers, would normally consider their use" (Pavement Maintenance Effectiveness Preventive Maintenance Treatments Participants Handbook, FHWA-SA-96-027). Preventive maintenance activities should typically be initiated by the Resident Engineer.

10.1.2 **Types of Preventive Maintenance Treatments**

There are three general types of preventive maintenance treatments: nonstructural overlays, minor pavement repairs and drainage. Nonstructural overlays and recycling apply only to flexible pavements. Minor pavement repairs and drainage apply to all types of pavements.

Nonstructural overlays are thin (40-50 mm) overlays that provide no improvement to the pavement structure. These products can do nothing to improve unstable mats, or correct drainage problems, and provide very little correction to cross-slope. Those concerns must be addressed separately. **Nonstructural overlays cannot be applied to rigid pavements as preventive maintenance.**

Minor pavement repairs are any treatments performed to correct minor isolated flaws in a pavement prior to failure, to prevent failure from occurring. Minor pavement repairs include partial depth repairs in rigid pavements, crack sealing and joint sealing. Pothole repairs in flexible pavements are only performed after failure of the pavement structure and are therefore not preventive maintenance.

Drainage maintenance is any work performed to maintain the efficiency of the pavement drainage system including removing debris from under guide rail, cleaning edge drains, drain outlets, and culverts, and removing excess vegetation and debris from roadside ditches. Repairs to crushed drains can be preventive maintenance if the repair is performed before the damaged drain causes failure of the pavement structure.

10.1.3 **Factors Affecting Performance**

Deciding to invest in some type of preventive maintenance is often the simplest part of the decision-making process. Learning about the available preventive maintenance treatments, their
specifications, and trying to factor in all the variables affecting their performance in order to maximize the life of the treatment selected is the most difficult. Numerous variables affect the performance of any preventive maintenance treatment, including: workmanship, seasonal and weather variations, equipment condition, material quality, pavement condition, and traffic volume. Every effort should be made to control as many factors as possible to ensure proper performance of the chosen treatment.

The most common performance problems are related to time and money. Performance suffers when work is rushed in an attempt to maximize daily output, when opening to traffic is rushed, or when seasonal limits are pushed. It is best to be conservative when estimating the area to be treated, time required, quantities needed and dollars available. Follow proper inspection and quality assurance procedures during construction.

Equipment condition and the materials used are often two of the easiest factors to inspect, and the most critical to the treatment’s performance. Making sure the equipment is in proper working order and verifying that proper materials are used will help obtain satisfactory performance.

One of the most often overlooked factors is pavement preparation. Each treatment may require a different level of preparation, but in all cases the resultant performance will be affected by this preparation. Proper inspection at this time will have a positive impact on the treatment’s performance.

Combining treatments on a pavement may be the most effective preventive maintenance measure. However, something as simple as over applying crack sealant can cause serious performance problems with a nonstructural overlay. Being familiar with the different maintenance treatments and their sensitivities to one another will help minimize related performance problems.

10.1.4 Including Preventive Maintenance in a Pavement Management System

Having a well designed pavement management system in place and functioning is essential for the effective use of preventive maintenance. All roadways in a pavement management program must be systematically evaluated for level of service. This data must be compiled into a database from which typical times to initiation of distress, and times to failure can be estimated for each of the pavement types and traffic loading levels in the system. From this information, the proper preventive maintenance treatments and time of treatment can be selected for each pavement. Using the rating system of the Highway Sufficiency Ratings Manual (HSRM), preventive maintenance should usually be applied to flexible pavements rated 6 and higher and rigid pavements rated at 8 or higher.

Transportation Maintenance Resident Engineers are the Department’s first line pavement managers. Their intimate knowledge of pavements in their residency is invaluable in carrying out pavement management strategies. As such, Resident Engineers are the primary decision makers
for identifying and scheduling preventive maintenance projects.

Note: Because these surface distress ratings in the HSRM are determined while surveying the pavement at the posted speed limits, they do not always provide the most accurate description of the pavement’s condition and should not be relied upon exclusively.
10.2 NONSTRUCTURAL OVERLAYS

Nonstructural overlays are asphalt surface courses designed to improve and protect the pavement, but offer no structural improvement to the pavement. The overlay treatments discussed in this section include:

- Single course surface treatment (chip seal)
- Quick-set slurry
- Micro-surfacing
- Paver-placed surface treatment
- Hot mix asphalt (HMA) (40 mm - 50 mm)
- 6.3 mm polymer-modified HMA
- Heater scarification of HMA pavement (surface preparation for overlay treatments)

Nonstructural overlays constitute preventive maintenance only when used on flexible pavements or rigid pavements that were previously overlaid with HMA. When used properly as preventive maintenance, these treatments prevent future cracking by delaying the aging process of the pavement. They can also correct minor flaws such as rutting, raveling, minor cracks, and reduced pavement friction. The advantages and disadvantages of each treatment are discussed in sections 10.2.1 through 10.2.7. When overlays are used directly on rigid pavements, they are classified either as corrective maintenance or pavement rehabilitation (see Chapter 5 of this manual).

The friction requirements given in the specification for each treatment, limit that treatment to certain types of traffic loadings. Certain products, because of their structure, can only be used on low-volume traffic roads and the friction aggregate requirements for these treatments reflect this limitation. The three types of traffic loadings used to specify friction aggregate in surface courses are described below. The specific traffic conditions under which each treatment can be used are described in the subsection for each treatment.

**Low-Volume Traffic** refers to 2- or 3-lane highways with a design-year, two-way AADT less than 8,000, or highways with more than 3 lanes and a design-year, two-way AADT less than 13,000.

**Downstate High-Volume Traffic** refers to 2- or 3-lane highways in the City of New York or the Counties of Dutchess, Nassau, Orange, Putnam, Rockland, Suffolk, or Westchester with a design-year, two-way AADT of 8,000 or greater, or highways in these areas with more than 3 lanes and a design-year, two-way AADT of 13,000 or greater.

**Upstate High-Volume Traffic** refers to 2- or 3-lane highways in all other areas of the State with a design-year, two-way AADT of 8,000 or greater, or highways with more than 3 lanes and a design-year, two-way AADT of 13,000 or greater.
10.2.1 Single Course Surface Treatment (Chip Seal)

Single course surface treatment is a thin overlay consisting of a heavy asphalt emulsion application followed by a single layer of clean, uniformly sized coarse aggregate of size designation 1 ST, 6.3 mm crushed stone. Surface treatments are used on flexible pavements only. The emulsion is applied to the cleaned road surface, and immediately covered with the stone. The stone is placed, producing a dense one aggregate thick layer with no bald spots or bleeding areas. The stones are then oriented and seated with pneumatic tire rollers. The emulsion must be allowed to cure before the road can accept traffic.

Surface treatment will seal the pavement, reducing oxidation and weathering of the surface. The reduction in oxidation will allow the pavement to remain resilient to fatigue and low temperature cracking. Minor surface distresses such as raveling may also be corrected or prevented. The final thickness of a surface treatment is approximately 10 to 15 mm.

The Office of General Service’s (OGS) contract for this item includes a one-year warranty. The contractor must repair any area retaining less than 90% of the aggregate before September of the following year, at no cost to the purchaser.

Due to the very coarse texture of this treatment, the quantity of striping material required to provide adequate visibility is greater than for other nonstructural overlays. When evaluating the use of this product, the increased striping costs should be considered.

The expected service life for surface treatment (chip seal) is 2 to 4 years.

10.2.1.1 Conditions for Use

Distress of candidate pavements should be limited to:
   1. Low severity cracking, raveling, or rutting.
   2. Infrequent corrugations, settlements, heaves, or slippage cracks.

Traffic restrictions for candidate pavements are:
   1. Low volume traffic only.
   2. Low to moderate truck traffic (< 10%).
   3. Recommended for two lane roads with less than 2000 AADT and low truck traffic.

10.2.1.2 Advantages

   1. Can be constructed one lane at a time without matching lanes before opening to traffic at the end of the day.
   2. Minimal change to pavement elevation.
3. Can be applied to mainline only with no elevation adjustment to the shoulders.
4. Can be applied on shoulders only with no elevation adjustment to the mainline.
5. One year warranty.

10.2.1.3 Disadvantages

1. Potential for loose stone (risk of damage to autos), may require multiple sweepings.
2. Provides no correction to cross-slope.
3. Thermoplastic and preformed markings will not adhere.
4. Requires long (length) lane closure.
5. Time to open to traffic is dependent on environmental conditions, and may be several hours.
6. Surface treatments can be susceptible to damage (stone loss) from snow removal equipment.
7. Short service life.
8. Cannot be constructed at night.

10.2.1.4 Construction Considerations

Weather and seasonal limitations apply as follows:
1. Earliest date of application is May 1.
2. Latest day of application is the last Saturday in August.
3. Minimum pavement temperature is 10°C.
4. Cure time is dependant on environmental conditions, and is significantly affected by the amount of exposure to sunlight. The greater the exposure to sunlight, the less time is needed for curing at a given temperature.

Pavement preparation consists of the following procedures:
1. Perform necessary crack sealing.
2. Remove all epoxy, polyester, thermoplastic and preformed pavement markings.
3. Clean the pavement.

Constructing a surface treatment consists of the following procedures:
1. Apply the asphalt emulsion.
2. Apply the stone to the asphalt emulsion.
3. Compact the stone with pneumatic tire rollers.
4. Treatment is allowed to cure before opening it to traffic.
5. Permanent markings are applied after 24 hours of cure.
10.2.1.5 Expected Failure Modes

1. Loss of aggregate (stripping).
2. Flushing.
3. Potholes and raveling at reflective cracks.

10.2.2 Quick-Set Slurry

Quick-set slurry is a mixture of asphalt emulsion, aggregate, mineral filler and water. The slurry is continuously mixed and applied to the pavement in a single lift with specialized equipment. There are two aggregate gradations available: Type II and Type III. The aggregate used is size 2MS or 3MS, depending on the mixture type. No compaction is required for quick-set slurry, but the emulsion must be allowed to cure before opening to traffic, usually 2-3 hours.

Quick-set slurry will seal the pavement, reducing oxidation and weathering of the surface. The reduction in oxidation will allow the pavement to remain resilient to fatigue and low temperature cracking. Minor surface distresses such as raveling may also be corrected or prevented. The final thickness of a quick-set slurry is approximately 5 to 15 mm.

Crack sealing should be performed at least 3 months prior to the application of quick-set slurry. It is recommended that all necessary crack sealing be completed during the previous construction season.

Preformed temporary markings are not recommended for quick-set slurry. It is recommended that paint be used for all temporary markings. The overlay requires at least 7 days of curing before the application of any permanent pavement markings.

The expected service life for quick-set slurry is 3 to 5 years.

10.2.2.1 Conditions for Use

Distress of candidate pavements should be limited to:
1. Low severity cracking, raveling, or rutting.
2. Infrequent corrugations, settlements, heaves, or slippage cracks.

Traffic restrictions for candidate pavements are:
1. Low volume traffic only.
2. Low to moderate truck traffic (<10%).
10.2.2.2 Selecting Type II or Type III gradation

Type II contains mostly fine aggregate. A typical lift thickness for Type II is 5 to 10 mm. The thin lift does not allow for profile corrections. Type II is best suited for roads with few cracks, and little surface distress.

Type III is a coarser mix requiring a thicker lift. A typical lift thickness for Type III is 10 to 15 mm. The thicker lift allows for use on roads with slightly higher levels of distress. The coarser aggregate is also better suited for roadways approaching the maximum AADT for low volume traffic roads (defined in Section 10.2).

10.2.2.3 Advantages

1. Can be constructed one lane at a time without matching lanes before opening to traffic at the end of the day.
2. Can be used to treat the mainline with no elevation adjustment to the shoulders.
3. Can be used to treat the shoulders with no elevation adjustment to the mainline.
4. Can be applied to the mainline only without covering the edge of pavement markings.
5. Edges and transitions may be feathered out.
6. Minimal change to pavement elevation.
7. Single pass operation.

10.2.2.4 Disadvantages

1. Provides no correction to cross-slope.
2. Difficult to obtain proper surface texture with hand tools.
3. Requires at least 7 days for emulsion to fully cure before permanent markings can be applied.
4. Time to open to traffic is dependent on environmental conditions, and may be several hours.
5. Equipment cannot account for shoulder breaks.
6. Cannot be constructed at night.

10.2.2.5 Construction Considerations

Weather and seasonal limitations apply as follows:

1. Seasonal limitations are governed by §402-3.01 of the Standard Specifications.
2. Minimum temperature is 10°C.
3. Cure time is dependant on environmental conditions, and is significantly affected by the amount of exposure to sunlight. The greater the exposure to sunlight, the less time is needed for curing at a given temperature.
Pavement preparation consists of:
1. Crack sealing should be performed at least 3 months before application of quick-set slurry.
2. Perform all required rut filling.
3. Remove all thermoplastic, and preformed markings.
4. Abrade all epoxy and polyester markings to remove the glass beads and roughen the surface.
5. Clean the pavement.

Constructing a quick-set slurry overlay consists of:
1. Apply slurry.
2. Allow slurry to cure until stable enough to support traffic.
3. Apply temporary striping.
4. Open roadway to traffic.
5. Apply permanent striping after 7 days of cure (minimum).

10.2.2.6 Expected Failure Modes
1. Potholes and raveling at reflective cracks.
2. Abrasion at intersections.

10.2.3 Micro-Surfacing

Micro-surfacing is a mixture of polymer modified asphalt emulsion, aggregate, mineral filler, and water, that has a slurry consistency during mixing and application. The micro-surfacing is continuously mixed and applied with specialized equipment. There are two mix types available based on aggregate gradation: Type II micro-surfacing uses a 2MS aggregate gradation and Type III micro-surfacing uses a 3MS aggregate gradation. The aggregate gradation requirements are listed in §703-02 Coarse Aggregate of the Standard Specifications.

Micro-surfacing overlays are always applied in two passes. The first pass, often called the scratch course, is applied to even out surface irregularities and prepare the pavement for the surface course. The surface course is applied to provide a smooth wearing course. No compaction is required, however, the emulsion must be allowed to cure before traffic is applied. Micro-surfacing will accept traffic within 1 hour after application under most conditions.

Micro-surfacing will seal the pavement, reducing oxidation and weathering of the surface. The reduction in oxidation will allow the pavement to remain resilient to fatigue and low temperature cracking. Minor surface distresses such as raveling may also be prevented or corrected. The final thickness of micro-surfacing is approximately 10 to 20 mm depending on the mix type used and the design application rate.
Ruts up to 9 mm deep can be filled in one pass concurrent with the initial paving pass. For ruts deeper than 9 mm, the rut filling operation is performed separately using Type III micro-surfacing applied with a specialized applicator, and paid for under a separate item. The depth of ruts must be taken into account when determining the total quantity of material needed for a project. The filled ruts can be covered with any appropriate nonstructural overlay.

Crack sealing should be performed at least 3 months prior to the application of micro-surfacing. It is recommended that all necessary crack sealing be completed during the previous construction season.

Preformed temporary markings are not recommended for micro-surfacing. It is recommended that paint be used for all temporary markings. The overlay requires at least 7 days of curing before the application of any permanent pavement markings.

The expected service life for micro-surfacing is 5 to 8 years. No traffic restrictions apply for this treatment, but appropriate friction aggregate must be used for the traffic volume and location.

### 10.2.3.1 Conditions for Use

Distress of candidate pavements should be limited to:
1. Low severity cracking and raveling.
2. Infrequent corrugations, settlements, heaves, and slippage cracks.
3. Wheel path rutting up to 25 mm.

### 10.2.3.2 Selecting Type II or Type III Micro-surfacing

Type II contains mostly fine aggregate. The final thickness of two applications of Type II is approximately 10 mm to 15 mm. The fine aggregate results in a very smooth dense surface, excellent for urban applications, and moderate traffic volume highways. Type II cannot be used for filling ruts deeper than 9 mm.

Type III is a coarser mix, and provides a thicker surface course. The final thickness of two applications of Type III is approximately 15 mm to 20 mm. The coarser aggregate provides a slightly more aggressive surface texture. The thicker lifts provide improved durability. Type III is recommended for highways with high traffic volume, and/or high truck traffic.

### 10.2.3.3 Determining the Application Rate

#### A. Rut Fill

This quantity must be calculated for any candidate that exhibits rutting, regardless of whether the ruts will be filled and paid for under a separate item. Calculating the exact quantity of
material needed to fill ruts is very difficult. The following table can be used to estimate the quantity of material needed. Adjustments to these quantities can be made based on experience.

**Table 10-1 Estimated Quantities for Rut Filling**

<table>
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<tr>
<th>Average Rut Depth</th>
<th>Estimated Rut Fill Application Rate (kg/m²)</th>
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<tbody>
<tr>
<td>0 to 12 mm</td>
<td>0 - 9</td>
</tr>
<tr>
<td>12 to 19 mm</td>
<td>9 - 14</td>
</tr>
<tr>
<td>19 to 25 mm</td>
<td>12 - 16</td>
</tr>
<tr>
<td>25 to 32 mm</td>
<td>13 - 17</td>
</tr>
<tr>
<td>32 to 40 mm</td>
<td>14 - 18</td>
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Multiply the estimated rut fill application rate by the total square meters of rutting (rut width x 2 x length x no. of lanes), to calculate the total mass of material needed. If the ruts are deeper than 9 mm, the quantity calculated above is bid under the Type III Rut Filling item. If the ruts are less than 9 mm deep, the quantity can be combined with the overlay quantity and bid under a single item.

**B. Overlay**

The application rate of the overlay depends on the level of distress and traffic conditions of the candidate. Typical application rates for Type II range from 14 to 22 kg/m². Typical application rates for Type III range from 20 to 32 kg/m². Micro-surfacing overlays are applied in at least 2 lifts. The rates provided here are totals for all lifts.

**10.2.3.4 Advantages**

1. Can be constructed one lane at a time without matching lanes before opening to traffic.
2. Can be applied to the mainline only with no elevation adjustment to the shoulders.
3. Can be applied to the shoulders only with no elevation adjustment to the mainline.
4. Can be applied to the mainline without covering the permanent edge of pavement markings.
5. Edges and transitions may be feathered out.
6. Minimal change to pavement elevation.
7. Can be used to fill rutting.
8. Open to traffic within one hour (advantage over chip seal and slurry seal).
10.2.3.5 Disadvantages

1. Two pass operation.
2. No correction for cross-slope.
3. Difficult to obtain proper surface texture with hand tools.
4. Requires at least 7 days for emulsion to fully cure before permanent markings can be applied.
5. Equipment cannot account for shoulder breaks.
6. Requires up to one hour before opening to traffic.

10.2.3.6 Construction Considerations

Weather and seasonal limitations apply as follows:

1. Seasonal limitations are governed by §402-3.01 of the Standard Specifications.
2. Minimum temperature is 10°C.
3. Cure time is dependant on environmental conditions, and is affected by the amount of exposure to sunlight. The greater the exposure to sunlight, the less time is needed for curing at a given temperature.

Pavement preparation procedures consist of:

1. Perform all required crack sealing.
2. Remove all thermoplastic and preformed pavement markings.
3. Abrade all epoxy and polyester markings to remove the glass beads and roughen the surface.
4. Clean the pavement.

Constructing a micro-surfacing overlay consists of:

1. Apply rut fill course if needed.
2. Allow rut fill course to cure for 1 day.
3. Apply initial course.
4. Allow initial course to cure before traffic or the second course is allowed.
5. Apply surface course.
6. Allow surface course to cure until it is stable enough to support traffic.
7. Apply temporary markings.
8. Allow traffic on the pavement.
9. Cure continues for at least 7 days before the permanent markings are applied.

10.2.3.7 Expected Failure Modes

1. Potholes and raveling at reflective cracks.
2. Subject to abrasion at high traffic acceleration areas (vehicles accelerating at traffic signals).
10.2.4 **Paver Placed Surface Treatment**

Paver placed surface treatment consists of a warm polymer-modified asphalt emulsion coat followed immediately with a thin hot mix asphalt (HMA) wearing course. A self-priming paver applies the warm emulsion coat directly in front of the paving screed. Three gradations are available for the HMA wearing course: Type A, B, or C. The nominal maximum aggregate sizes are 6.3 mm, 9.5 mm, and 12.5 mm for Types A, B, and C respectively. The HMA overlay is placed in 1 lift, having a final thickness of 1 to 1.5 times the diameter of the coarsest aggregate.

Paver placed surface treatment will seal the pavement, reducing oxidation and weathering of the surface. The reduction in oxidation will allow the pavement to remain resilient to fatigue and low temperature cracking. Surface distresses such as raveling and moderate rutting (defined in Chapter 2, Appendix 2A) may also be corrected. The final thickness of paver placed surface treatment is 12 mm for Type A, and 20 mm for Types B and C.

There are no traffic restrictions for paver placed surface treatment. The expected service life of paver placed surface treatment is 5 to 8 years.

10.2.4.1 **Conditions for Use**

Distress of candidate pavements should be limited to:
1. Low severity cracking, or raveling.
2. Infrequent corrugations, settlements, heaves or slippage cracks.
3. Medium severity rutting.

10.2.4.2 **Selecting Type A, Type B, or Type C.**

Type A is a 6.3 mm nominal maximum aggregate size mix. This mix is considered to be the lightest duty mix. Its fine surface texture is excellent for urban and suburban applications with light truck traffic. Type A is not recommended for highways that are borderline candidates for preventive maintenance. One of the coarser gradations should be used in those applications.

Type B is a 9.5 mm nominal maximum aggregate size mix. This mix is durable enough to handle moderate to heavy traffic and truck traffic on highways with moderate speeds. Type B can also be used in lighter duty applications if a slightly thicker lift is desired, or if more surface distress is present.

Type C is a 12.5 mm nominal maximum aggregate size mix and the most heavy-duty mix. Type C can be used for any application, regardless of traffic levels. This mix is recommended for high speed, high traffic applications, and for applications with moderate rutting.
10.2.4.3 Advantages

1. Can be constructed one lane at a time without matching lanes before opening to traffic.
2. Requires only a short, single lane, moving traffic closure.
3. Can correct wheel path rutting up to 13 mm with a single pass.
4. Can be opened to traffic immediately after rolling.
5. Minimal change in pavement elevation.
6. Can be applied to mainline only, with no adjustment to the shoulders.
7. Can reduce water spray from traffic on wet pavement.

10.2.4.4 Disadvantages

1. Minimum correction to cross-slope.
2. Edges and transitions cannot be feathered. Milling rebates may be required.

10.2.4.5 Construction Considerations

Weather and seasonal limitations apply as follows:
1. Seasonal limitations governed by §402-3.01 of the Standard Specifications.
2. Minimum temperature is 10°C.

Pavement preparation procedures consist of:
1. Perform all required crack sealing.
2. Remove all thermoplastic and preformed pavement markings.
3. Abrade all epoxy and polyester markings to remove the glass beads and roughen the surface.
4. Clean the pavement.

Constructing a paver placed surface treatment consists of:
1. Apply emulsion and HMA with a self priming paver.
2. Apply compaction.
3. Temporary pavement markings and traffic are allowed as soon as the surface temperature allows.
4. Apply permanent markings.

10.2.4.6 Expected Failure Modes

1. Potholes and raveling at reflective cracks.
2. Raveling.
10.2.5 **Hot Mix Asphalt, 40-50 mm**

Hot mix asphalt (HMA) overlays may be any appropriate top course mixture. The specific mix type and compaction requirements will depend on the design traffic loading of the pavement. Contact the Regional Materials Engineer for support.

There are no traffic restrictions for HMA overlays; however, mixture selection is based on traffic loading. The expected service life of a 40-50 mm hot mix asphalt overlay is 5 to 8 years.

10.2.5.1 **Conditions for Use**

Distress of a candidate pavement should be limited to:

1. Low-severity cracking.
2. Infrequent corrugations, settlements, heaves, slippage cracks, or raveling.

10.2.5.2 **Advantages**

1. Paver can adjust for shoulder break to allow paving of mainline and shoulders.
2. Allows for some correction of cross-slope.
3. Hand work is easier than with other overlays.
4. No need to remove epoxy pavement markings.

10.2.5.3 **Disadvantages**

1. Crack sealing and rut filling must be performed prior to construction to achieve service life.
2. Increases elevation of pavement, decreases curb reveal and guide rail height.
3. Must pave mainline and shoulders.
4. Need to remove preformed pavement markings.
5. Requires a relatively long paving train.
6. Usually requires a shoulder backup.
10.2.5.4 Construction Considerations

Weather and seasonal limitations apply as follows:
   1. Seasonal limitations governed by §402-3.01 of the Standard Specifications.
   2. Minimum temperature is 8°C.

Pavement preparation consists of:
   1. Perform all required crack sealing.
   2. Remove all preformed pavement markings.
   3. Clean the pavement.

Constructing a 40-50 mm HMA overlay consists of the following procedures:
   1. Apply a tack coat.
   2. Apply the HMA.
   3. Compact the overlay.
   4. Apply temporary markings after surface temperature drops.
   5. Traffic is allowed as soon as mat cools enough to support the loading.
   6. Apply permanent markings.

10.2.5.5 Expected Failure Modes

   1. Reflective cracking.
   2. Low temperature cracking.
   3. Rutting or shoving at intersections.
   4. Potholes.
   5. Raveling.
**PREVENTIVE MAINTENANCE**

**10.2.6 6.3 mm Polymer-Modified HMA, 19-25 mm**

A 6.3 mm polymer-modified HMA overlay is an appropriate top course mixture. There are no traffic restrictions for a 6.3 mm polymer-modified HMA overlay. The expected service life of a 19-25 mm thick 6.3 mm polymer-modified HMA is 5 to 8 years.

The specification requires the use of a Polymer-Modified PG Binder in the mixture and the use of a rapid setting asphalt emulsion as a tack coat, which will cause an increased cost per ton. Designers should estimate a cost of approximately 25% more per ton of mixture as compared to regular HMA mixtures.

Item number selection will depend on design traffic loading of the pavement. Use the table below to select the appropriate Item number for the anticipated traffic conditions. Contact the Regional Materials Engineer for support.

<table>
<thead>
<tr>
<th>Anticipated Traffic Conditions ¹,²</th>
<th>Appropriate Item Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downstate High Volume</td>
<td>402.067101 18 M</td>
</tr>
<tr>
<td>Upstate High Volume</td>
<td>402.067201 18 M</td>
</tr>
<tr>
<td>Low Volume</td>
<td>402.067301 18 M</td>
</tr>
</tbody>
</table>

1. "High Volume" refers to 2- or 3-lane highways with design year two-way AADT over 8,000, or for more than three lanes, with two-way AADT over 13,000. "Low Volume" refers to highways with lower volumes for the specified number of lanes.

2. The City of New York and the surrounding counties of Dutchess, Nassau, Orange, Sullivan, Putnam, Rockland, Suffolk, and Westchester are referred to as “downstate.” All other areas are referred to as “upstate.”

**10.2.6.1 Conditions for Use**

Distress of a candidate pavement should be limited to:

1. Low-severity cracking.
2. Infrequent corrugations, settlements, heaves, slippage cracks, or raveling.

**10.2.6.2 Advantages**

1. Paver can adjust for shoulder break to allow paving of mainline and shoulders.
2. Hand work is easier than with other treatments.
3. No need to remove epoxy pavement markings.
4. Edges can be feathered.
5. Only a slight increase to the pavement elevation.

**10.2.6.3 Disadvantages**

1. Crack sealing and rut filling must be performed prior to construction to achieve service life.
2. Need to remove preformed pavement markings.
3. May requires a relatively long construction zone.
4. Transitions cannot be feathered. Milling rebates may be required.

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11/29/04
10.2.6.4 Construction Considerations

Weather and seasonal limitations are governed by §402-3.01 of the Standard Specifications.

Pavement preparation consists of:
1. Perform all required crack sealing and rut filling.
2. Remove all preformed pavement markings.
3. Clean the pavement.

Constructing a 6.3 mm polymer-modified HMA overlay consists of the following procedures:
1. Apply a tack coat.
2. Apply the 6.3 mm polymer-modified HMA.
3. Compact the overlay.
4. Apply temporary markings after surface temperature drops.
5. Traffic is allowed as soon as mat cools enough to support the loading.
6. Apply permanent markings.

10.2.6.5 Expected Failure Modes

1. Reflective cracking.
2. Low temperature cracking.
3. Shoving at intersections.
4. Potholes.
10.2.7 **Heater Scarification of Hot Mix Asphalt (HMA) Pavement**

Heater scarification is an optional surface preparation technique to recycle and rehabilitate the top course of an existing asphalt pavement prior to a preventive maintenance overlay. It is a multi-step process, in which the existing asphalt pavement is heated and scarified with specialized equipment. Depth of the asphalt pavement to be scarified is usually between 25 mm and 50 mm. The only new material added to the pavement is an asphalt recycling agent which improves the properties of the aged asphalt. This mix is then reshaped and compacted back onto the roadway. A preventive maintenance treatment overlay is placed over the recycled pavement.

Heater scarification improves the existing pavement’s ability to remain resilient to fatigue and low-temperature cracking. This process will help restore proper drainage by improving the pavement surface and cross-section deformed by rutting or traffic wear.

When used properly, heater scarification is expected to delay distress from the underlying pavement and extend the overlay’s expected service life by an additional 2 years.

The specification requires the Contract documents to include the following:

- Descriptive notes of the core locations along with their test results for percent of recovered asphalt content, aggregate gradation, and original penetration value for each sample.
- The depth of existing HMA pavement depth to be scarified in millimeters. (Maximum allowable depth to be scarified is 50 mm).

In order to obtain this information, core samples have to be taken from the existing HMA pavement. The designer must coordinate with the Regional Materials Engineer to obtain these cores for testing. This test data will be used by the Contractor to determine the application rate of the recycling agent.

For bidding purposes, the estimated quantity of asphalt recycling agent will be 0.45 liters per square meter of heater scarified hot mix asphalt (HMA) pavement.

10.2.7.1 **Conditions for Use**

Distress of a candidate pavement should be limited to:

1. Low-severity cracking.
2. Structurally sound pavement with infrequent settlements, heaves, slippage cracks, raveling, medium- and/or high-severity cracking.
3. Corrugations.
4. Low- or medium-severity wheel path rutting and/or widening drop-off.
5. Pavement core evaluation must meet warrants for recycling.
6. If the pavement is rutted, the cause of the rutting must be evaluated to determine if rutting has ceased.
10-17d

PREVENTIVE MAINTENANCE

10.2.7.2 Advantages

1. Can be done one lane at a time.
2. Overnight lane closures not required.
3. Crack sealing, shimming wheel ruts, or truing and leveling (T&L) is not required.
4. Maintains existing profile.
5. Delays reflective cracking in overlay.

10.2.7.3 Disadvantages

1. Manholes or drainage inlets will damage recycling equipment.
2. Emissions may be objectionable in residential areas.
3. Extra caution must be used because high temperatures may damage vegetation close to road.
4. Must be overlaid with a preventive maintenance item.

10.2.7.4 Construction Considerations

Weather and seasonal limitations are governed by §402-3.01 of the Standard Specifications for minimal compacted lift thickness <50 mm.

Constructing an asphalt pavement using heater scarification consists of the following procedures:

1. Apply heat to the existing asphalt pavement.
2. Scarify the heated pavement with specialized equipment.
3. Add the asphalt recycling agent to the scarified pavement.
4. Reshape and compact the paved surface.
5. Apply temporary markings after surface temperature drops.
6. Traffic is allowed as soon as mat cools enough to support the loading.
7. The preventive maintenance overlay must be placed prior to the end of the paving season.

10.2.7.5 Expected Failure Modes

See expected failure mode of preventive maintenance overlay.
10.3 MINOR PAVEMENT REPAIRS

Minor pavement repairs are any work performed on a pavement to remediate specific, low-severity, or isolated distresses. The current Department treatments for minor repairs include:

- crack sealing (flexible pavement only)
- joint sealing (PCC pavements)
- partial depth spall repairs (PCC pavements)
- combinations of these treatments.

Early in a pavement’s life, when low-severity or isolated distresses appear, these repairs may be performed to delay the need for more extensive maintenance or rehabilitation. As the pavement ages, the frequency and/or severity of the distress may increase, reducing the pavement’s condition rating. These treatments can then be used to prepare the pavement for a nonstructural overlay (flexible pavements only). Minor repairs are just that, minor, and should not be used by themselves once medium-severity distress has occurred. If the application of these treatments is delayed until medium severity distress is present, their use is not preventive maintenance.

This chapter considers only flexible pavements and jointed plain (unreinforced) concrete pavements (JPCP). The vast majority of concrete pavements constructed by the Department have been jointed reinforced concrete pavement (JRCP); however, the age of these pavements places them beyond the scope of preventive maintenance. Corrosion in a JPCP slab is not a concern because it does not contain reinforcing steel. Also, cracks in JPCP constitute a pavement failure. For these two reasons, cracks in JPCP must be repaired by retrofitting the crack with dowel bars, turning the crack into a joint. Dowel bar retrofit is a concrete pavement rehabilitation (CPR) technique. Refer to Chapter 5 of this manual for further guidance on CPR. Preventive maintenance of JPCP is limited to resealing joints and partial depth spall repairs.

Project Selection

Resident Engineers are the primary decision makers for identifying and scheduling minor pavement repairs. They decide which roads need sealing, the appropriate sealing treatment, and the contract arrangements for completing the work. Parameters outlined in these guidelines will help with project selection and in choosing a sealing method. Deciding whether to seal cracks with State forces or by contract involves consideration of factors that vary with the residency. Some examples are workload, personnel skill level and experience, project location, volume of traffic, availability of competent contractors in the area, OGS contract availability, etc. The Regional Pavement Management Group may review the candidate projects, sealing methods, and contract type selected by the Resident Engineer for program and funding compatibility.

Briefly outlined below is a five-step procedure recommended for selecting projects to include in a pavement sealing program, and for designing their cost-effective treatments.
1. Maintain a database of pavement work histories. Minimum types of information to include are: pavement type, pavement location, the category of work, limits of work, and date of work. Basic pavement types are: full-depth PCC, full-depth HMA, and HMA overlays of PCC. The broad categories of work associated with each pavement type are: reconstruction, rehabilitation, corrective maintenance, and preventive maintenance. Joint and crack sealing are specified for each of these work categories. For a complete description of treatments and their timing, refer to the Pavement Rehabilitation Manuals, Volumes I and II, in Chapters 2 and 5 of this manual, respectively.

2. Identify candidate pavements. Do a sort on the database to produce a list of pavements that are candidates for sealing. Key criteria are pavement type, the category of work, and date of work.

3. Evaluate pavement condition. Pavement condition and the condition of previous work are important factors when deciding whether a sealing project is appropriate. Each pavement listed in the database sort requires a field investigation to evaluate its condition. For PCC pavements, the age of the pavement drives the scheduling of joint and crack sealing. Joint seals, however, need to be checked periodically for premature failure. For HMA pavements, cracks should ideally be sealed as soon as they appear; however, upon inspection, may have too few cracks for sealing by contract at the time. These pavements will need a field inspection again the following year to decide if distress levels are now appropriate for sealing. Severely distressed pavements are not good candidates for sealing. The purpose of crack sealing is to slow distress development, not correct it. Crack sealing is not a solution for making a seriously distressed pavement last through another winter. The Conditions for Use section under each treatment describes the level of cracking considered acceptable at the time of construction for the sealing of HMA pavements.

4. Select pavement sealing treatment and decide contract arrangements. The type, age, and physical condition of the pavement and previous work are important factors in designing and scheduling joint and crack sealing projects. Keep in mind that a pavement will continue to deteriorate after the field investigation until work is done to stop deterioration or improve condition. Some pavements may even fall apart over a winter to a point where they may no longer be good candidates for sealing. It is, therefore, important to schedule a project for work before the pavement distresses reach the upper levels considered acceptable for sealing.

   Equally important is the remaining service life of the pavement, which must be greater than the expected life of the planned sealing treatment. Pavement sealing is not a good investment if the treatment outlasts the pavement.

   Sealing specifications for HMA pavements offer choices in crack preparation and in the method of measurement for payment purposes. A rout and seal treatment may last five years compared to two years for a clean and seal treatment. Routing of the full-width
transverse cracks in HMA pavements is an effective treatment because thermal movement is greatest with this type of crack. Consider a rout and seal treatment if the remaining life of the pavement may exceed five years. The Regional Materials Engineer can help with an assessment of remaining pavement life.

Other factors important to each Region must be considered to complete the project. Some examples are, who will do the work (State forces or contractors) and the funding source.

5. Set priorities. Available resources may limit what work gets done and when. Following is a prioritized listing of the work categories considered cost-effective:

a. Resealing Joints (Transverse and Longitudinal) in PCC Pavement.

b. Sealing Cracks in PCC Pavement.

c. Filling PCC-Pavement/HMA-Shoulder Joints.

d. Routing and Sealing Cracks in HMA Pavement.

e. Cleaning and Sealing Cracks in HMA Pavement.

Regions may establish sub-priorities within the above categories of work to account for pavement age and traffic volume. Generally, sealing projects on young pavements with high traffic volumes (or many trucks) are very cost-effective.

There are no traffic restrictions for any of these treatments.

10.3.1 Partial Depth Repairs of Jointed Plain Concrete Pavements

Partial depth repair corrects localized surface distress, such as joint spalling located primarily in the upper one-third of a concrete pavement. Surface spalls can create a rough ride and accelerate development of further distress problems. Partial depth repairs replace unsound concrete, restore a smooth ride, deter further deterioration and provide suitable edges for effective joint and crack resealing.

Installing a partial depth repair involves determining the extent of the deterioration, removing the deteriorated concrete, thoroughly cleaning the repair area, placing the repair material, and reforming the joint.

Spalls that are smaller than 12 mm by 150 mm do not typically affect ride quality and do not require a partial depth repair.
Good judgement is essential in defining limits for partial depth repairs. Do not attempt to cut costs by limiting repair size, despite the expanse of deterioration. Such practice can reduce the repair’s ability to extend pavement service life. It is important to remember that the majority of the cost is in repair preparation. Since the preparation effort is similar for smaller and larger repairs, smaller repairs do not significantly reduce costs.

Estimating the quantity of repair areas can be difficult. The area of deteriorated concrete is often much larger than the resulting surface distress. Extensive evaluation and conservative calculations are recommended when estimating quantities.

10.3.1.2 Conditions for Use

Spalls should be of 1 m$^2$ or less in area with the larger dimension no more than two times the smaller, and less than 100 mm deep.

10.3.1.3 Advantages

1. Overnight lane closures may not be required.
2. Small areas can be repaired with rapid setting products.
3. Heavy equipment not required.
4. Improves ride.

10.3.1.4 Disadvantages

1. Restricted by temperature and moisture.
2. Requires intensive preparation of the repair area.
3. Must strictly adhere to rapid setting repair material instructions.
4. Extended time for traffic control.

10.3.1.5 Construction Considerations

Weather seasonal limitations apply as follows:
1. Most concrete repair materials cannot be used below 10°C.
2. Repair materials require different curing techniques.

The surrounding pavement does not need to be prepared prior to removing the material from the repair area.

Constructing partial depth repairs consists of:
1. Saw cut the repair perimeter 20 mm deep with a diamond blade saw.
2. Remove the damaged concrete using 20 kg or lighter hammers and appropriate bits.
3. Blast clean the repair area.
4. Prepare the repair area as recommended by the repair material manufacturer.
5. Form adjacent joints.
6. Place, consolidate, and finish repair material.
7. Cure the repair for required period.
8. Allow traffic on repair after cure.
9. Clean and seal adjacent joints.

Common repair materials include:
1. Concrete Repair Materials (Item 701-04, Approved List)
2. Rapid Setting Concrete Repair Materials (Item 701-09, Approved List)
3. High Early Strength PCC Mixtures (Contact the Materials Bureau)
4. Specialty Cement Concrete Mixtures (Contact the Materials Bureau)
5. Rapid Setting Polymer Concrete (Item 721-20, Approved List)

10.3.1.6 Expected Failure Modes
1. Bond failure between repair and pavement.
2. Cracking of repair.

10.3.2 Resealing Joints in Jointed Plain Concrete Pavement

Joint resealing is a cost-effective strategy for extending a pavement's service life. Resealing should be performed on joints that are in good condition. Partial depth repairs can be performed to allow the joint to accept sealant. For JPCP, the age of the pavement drives the scheduling of joint sealing. Joint seals, however, need to be checked periodically for premature failure.

Resealing joints reduces the accumulation of incompressible material in the joint. Incompressible material retained in rigid pavement joints or cracks can lead to spalls and/or blowups in hot weather.

Resealing joints, reduces the amount of surface water entering the subbase, slowing pavement deterioration and extending service life. Surface water infiltrating through the cracks and joints can penetrate into the base and subbase materials, causing a loss of strength in these materials. Load-related failures may result. This type of failure is not as critical for pavement designs using drainable base layers (ex. permeable base layer with edge drains).

Joint sealing provides no improvement to ride or drainage. If the quality of the ride has suffered due to cracking, failure has occurred, and it is too late for preventive maintenance.
The expected service life of resealed joints in plain concrete pavement is 8 years.

10.3.2.1 Conditions for Use

The conditions for resealing transverse and longitudinal joints in PCC pavement are:
   1. No sign of alkali silica reaction or D-cracking.
   2. Low-severity spalling (spalls may be repaired before sealing).

The conditions for resealing longitudinal joints between PCC pavement and HMA shoulders are:
   1. No alkali silica reaction or D-cracking.
   2. Low-severity spalling (spalls may be repaired before sealing).
   3. Low level shoulder distress.

10.3.2.2 Advantages

   1. Overnight lane closures are not required.
   2. Can seal widths up to 40 mm; however, the quality of the ride suffers when wider than 20 mm.

10.3.2.3 Disadvantages

The use of sealing materials is restricted by temperature and moisture.

10.3.2.4 Construction Considerations

Weather and seasonal limitations apply as follows:
   1. Dry weather is required for sealant to cure properly.
   2. Air and pavement temperature should be in the middle of the annual temperature range.
   3. Air temperature must be > 5 °C above the dew point.
   4. Summer application is preferred for resealing joints in PCC pavement.
   5. Spring or fall application is preferred for sealing longitudinal joints between PCC pavement and HMA shoulders.

Joint preparation consists of:
   1. Remove the old sealant.
2. Remove all debris from the joint.
3. Perform all necessary spall repairs.
4. Saw additional joint width if necessary.
5. Abrasive blast clean each wall of the sealant reservoir.
6. Air blast each wall of the sealant reservoir.
7. Dry the crack thoroughly (hot air lance may be used).
8. Place the backer rod to the proper depth.

The process for resealing joints in PCC pavements consists of:
1. Extrude sealant into the sealant reservoir such that the sealant is 3 mm below the surface of the pavement.
2. Silicone is the recommended sealant. ASTM D3405 is acceptable for longitudinal joints.
3. Tool the sealant if necessary.

The process for filling joints between PCC pavements and HMA shoulders is as follows:
1. Clean the joint with compressed air, hot air lance, or wire brush.
2. Pour the filler material into the joint (use backer rod if joint is wide).
3. Recommended material is ASTM D3405.
4. Squeegee the filler such that a band of filler 3 mm high and 100 mm wide is left over the pavement/shoulder joint. Be sure not to obscure pavement markings.

10.3.2.5 Expected Failure Modes
1. Bond failure between the sealant and pavement.
2. Failure of PCC at or near the interface with the sealant.

10.3.3 Sealing Cracks and Routing and Sealing Cracks in HMA Pavements

Surface water infiltrating through cracks can penetrate into the base and subbase materials, causing a loss of strength in these materials. Load-related failures may result. By sealing cracks, the amount of surface water entering the pavement is reduced, slowing deterioration and extending service life. Crack sealing provides no improvement to the quality of ride or drainage. If the quality of ride has suffered due to cracking, failure has occurred, and it is too late for preventive maintenance. Severely distressed pavements are not good candidates for sealing.

10.3.3.1 Sealing

Crack sealing is a cost-effective strategy for extending a pavement’s service life. By sealing the pavement when cracks first appear, the pavement remains watertight slowing subsequent pavement deterioration. Crack sealing should be performed on cracks that are in good condition.
The objective of crack sealing is to prevent the formation of future cracks. In flexible pavements, the initial cracking is usually narrow with no surrounding distress. If this condition is not treated, the intrusion of water and incompressibles can lead to fatigue cracking and failure of the pavement structure. The expected service life of crack sealing is 2 years.

Crack sealing operations should not be scheduled within 1 year of an HMA overlay, or within 3 months of a quick-set slurry or micro-surfacing overlay.

10.3.3.2 Routing and Sealing

Routing of the full-width transverse cracks in HMA pavements is an effective treatment because thermal movement is greatest with this type of crack. The work consists of routing a sealant reservoir in well defined single cracks (a transverse thermal crack for example), cleaning the openings by high pressure air blasting and sealing. Consider a rout and seal treatment if the remaining life of the pavement may exceed 5 years. The Regional Materials Engineer or Regional Pavement Manager can help with an assessment of remaining pavement life. The expected service life of routing and sealing is 5 years.

10.3.3.3 Conditions for Use

1. Well defined and spaced cracks with little or no secondary cracking.
2. Average spacing no closer than 6 m between cracks.
3. Less than 25% of the crack's length should have secondary cracking.

10.3.3.4 Advantages

1. Overnight lane closures are not required.
2. Proper application delays need for more expensive overlays.

10.3.3.5 Disadvantages

1. Restricted by temperature and moisture.
2. Improper application will decrease effectiveness of subsequent treatments (overlays).

10.3.3.6 Construction Considerations

Weather and seasonal limitations apply as follows:
1. Dry weather is required for sealant to cure properly.
2. Air and pavement temperature should be in the middle of the annual temperature range.
3. Air temperature must be > 5°C above the dew point.
4. Spring and fall application is preferred.

Sealing or routing and sealing cracks consists of:
1. Rout the crack if performing rout and seal.
2. Thoroughly clean all debris from the crack.
3. Dry the crack thoroughly (hot air lance may be used).
4. Apply the sealant (ASTM D3405 from Approved List) into the crack or reservoir.
5. Squeegee the sealant to a thin film no wider than 50 mm and no thicker than 1 mm.

10.3.3.7 Expected Failure Modes
1. Bond failure between the sealant and the pavement.
2. Degradation of the HMA at or near the interface with the sealant.
10.4 DRAINAGE MAINTENANCE

It is widely known that a key element for successful pavement performance is a properly functioning drainage system. The most important function of the drainage system is to quickly rid water from the road surface plus inside the pavement, so proper maintenance means keeping existing edge drains, underdrains, outlet pipes, drainage structures and ditches clear and running.

By the time pavement distress is identified, the subgrade and subbase usually have already failed and the problem cannot be corrected without removing the pavement. Sealing the pavement is not effective in the long term without correcting drainage problems. Unfortunately, inadequate or nonexistent maintenance of drainage systems is a universal problem.

Maintaining the edge drain and underdrain outlets has become an even more critical factor with the newer pavement designs, which include a permeable base layer to collect and channel water to the edge drain. The new designs which are described in Chapter 9 of this manual, account for this by including more outlets and installing the outlets with 45° connections to enable inspection and clean-out. Also, precast concrete headwalls are specified for many of the outlet drains to prevent the pipe ends from collapsing and to help locate the outlets easily.

10.4.1 Inspect and Flush Out Clogged Drainage Systems

Lack of water flowing from a subsurface drain outlet often means that the drainage system is damaged, through improper installation or a crushed or plugged drain or outlet. If it is suspected there is a clogged drainage system, drainage inspection should be done by either pouring water on the pavement and checking the outflow, or using video inspection.

The first technique can be done by pouring a large volume of water (50 to 100 gallons) onto the pavement surface midway between outlets and verifying outflow: the more outflow and the sooner it exits the outlets the better. This should be done after a rainfall event, so the subgrade/subbase is saturated. If there is poor drainage, the system may be either clogged or the outlet pipe crushed. If it is a stone trench and pipe systems it may need to be flushed out. If the clogged system is a prefabricated geocomposite edge drain (PGED), portions of the system may have to be replaced.

Video inspection involves sending a video probe into the outlet end and inspecting the edge drain and outlet for discontinuities or problems. These inspections are mainly done for quality control during construction but may be used if there is reason to believe the system is not working properly. A specification for video inspection is listed in Appendix 5B of this manual.

If it is evident the edge drain or underdrain pipe has been crushed it should be repaired or a new outlet put in at this location.

If the drainage system is clogged with debris it should be flushed. Cleaning clogged drainage systems can be accomplished with sewer jets or water jets which discharge water from a large tank
or an abundant water source into the outlet and through the drainage system.
10.4.2 **Inspect and Repair Outlet Openings**

The combination of debris, vegetation and fines discharging from the edge drains may eventually plug the outlet pipe. Rodent nests, mowing clippings, and sediment collecting on rodent screens at the headwalls are common maintenance problems. Outlets often cannot be located because they are hidden by vegetative growth. Some outlets are so plugged that water gushes from the pipes when the obstructions are removed.

Visual inspection of the outlets should be done within two years of construction, and thereafter at sites which have had past problems. Debris and/or vegetation should be cleaned out of the outlet opening and rodent screens replaced. If the outlet pipe connections to headwalls or drainage structures are damaged they should be repaired or replaced. Damaged headwalls should either be repaired or replaced with an outlet pipe.

Outlet pipes that are crushed or damaged should be replaced. Replace the outlet pipe with a minimum length of 1.5 m of double-wall, perforated polyethylene pipe with a smooth interior and the same diameter as the existing outlet pipe (usually 100 mm or 150 mm.) This pipe comes in straight lengths and is better able to resist crushing from mowers and construction equipment than typical single-wall polyethylene underdrain pipe or steel corrugated pipe. Connect the new outlet pipe to the underdrain with standard fittings, slope the outlet pipe for positive flow, cut the end flush with the slope face and wrap the end with wire mesh (rodent barrier). Surround the outlet pipe with #2 and #3 crushed stone 300 mm wide by 300 mm or more deep, with the stone extending downslope 1 m.

Outlets should be located for future maintenance cleanouts with outlet markers. If the outlets can not be found, no maintenance can be performed. These outlet markers may be: paint marks on the paved shoulder or guide rail; special plant groupings placed above the outlet locations; or preferably, metal or plastic marker posts placed on the slope at the outlet or placed clear of the shoulder. Outlet markers should be placed outside the design clear area for the road or behind the guide rail. If the clear area for the road section is unknown, contact Regional Design for a recommended clear area.

10.4.3 **Cleaning Ditches**

A free-draining ditch is important for the drainage system. If ditches are filled with debris and/or vegetation to the point water is backing up or perhaps overflowing the roadway, they should be cleaned out to their original profile or enough to achieve positive drainage. Care should be taken when cleaning and reshaping ditches to use recommended ditch shapes from the AASHTO Roadside Design Guide, so they are traversable and won’t channel a vehicle toward a hazard. Contact Regional Design for advice on ditch shapes, location, and clear area.

If the effective ditch depth needs to be increased due to poor drainage but digging out the ditch is not possible, one solution is to construct a stone trench consisting of an underdrain pipe wrapped
in crushed stone. Excavate the bottom of the existing ditch a minimum 300 mm wide and deep enough and long enough to achieve positive drainage or provide enough trench volume to accommodate normal drainage conditions, which may not always be possible. Use #2 and #3 crushed stone or underdrain filter material. For ditches within the clear zone of the roadway, cover the #2 and #3 crushed stones with geotextile fabric and 150 mm of soil. Note that this stone trench option may only be a temporary fix, since it might clog up with fines, and a permanent roadway or drainage rehabilitation may be needed.
10.5 REFERENCES

Innovative Contracting Procedures (TE-14), FHWA
SHRP Innovative Material Development (H-106)
SHRP Studies in Preventive Maintenance Effectiveness (H-101)


Advice

Not every pavement manager, or maintenance engineer is familiar with every treatment described in this manual. Some project decision makers may be reluctant to select treatments with which they are not familiar. This manual is analogous to a mechanics toolbox. No mechanic would attempt to perform a repair armed only with an adjustable wrench and a screwdriver. Likewise, no treatment in this manual is the answer to every pavement. Even treatments as similar in performance as micro-surfacing and paver placed surface treatment have significant differences that may make either more desirable for a given pavement.

Detailed information on the treatments presented in this manual is available from many sources. If you are not familiar with a particular treatment, ask someone who is. Others in your program area, the Main Office Materials Bureau and Maintenance Division, Regional Materials Engineers and even the contractors themselves can be valuable sources of information. Other states have experience that can be accessed, and many government and industry organizations are accessible to answer your questions via the Internet. Travel to a project site in a neighboring area to see the operation in person. Occasionally training is offered on some of the treatments, participate whenever you can.

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