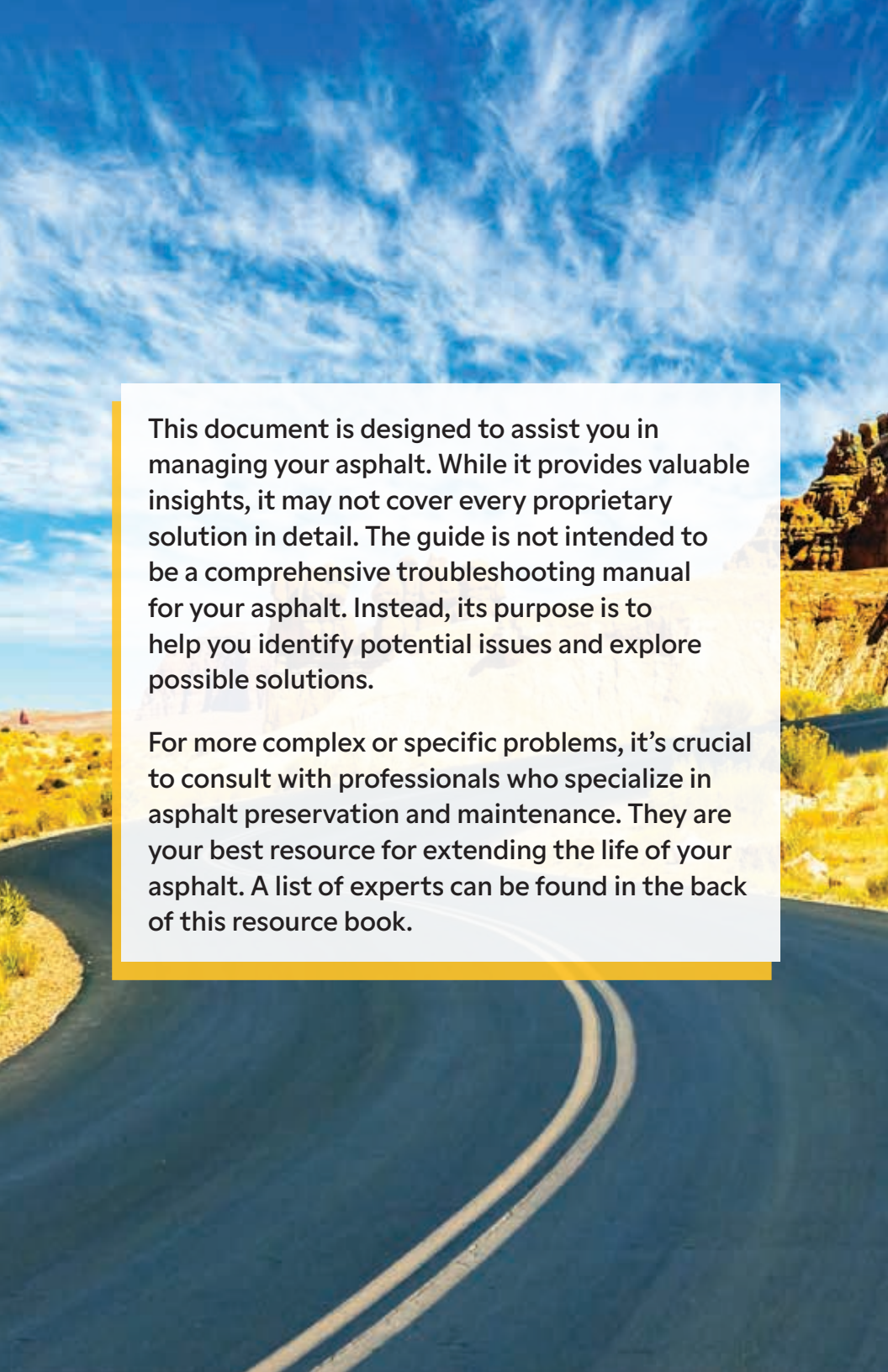
# PRESERVATION & MAINTENANCE TREATMENTS

FEBRUARY 2025



This document is designed to assist you in managing your asphalt. While it provides valuable insights, it may not cover every proprietary solution in detail. The guide is not intended to be a comprehensive troubleshooting manual for your asphalt. Instead, its purpose is to help you identify potential issues and explore possible solutions.

For more complex or specific problems, it's crucial to consult with professionals who specialize in asphalt preservation and maintenance. They are your best resource for extending the life of your asphalt. A list of experts can be found in the back of this resource book.

On behalf of the Utah Asphalt Pavement Association's (UAPA) Pavement Preservation Committee, I am pleased to introduce a valuable resource dedicated to enhancing the maintenance and preservation of asphalt pavements throughout Utah.

We hope that municipalities, property management professionals, school districts, developers, homeowner associations, churches and all owners of asphalt roads and parking lots will benefit from the collective experience and knowledge of UAPA's membership. By leveraging this expertise, we can work together to ensure the longevity and performance of our asphalt infrastructure.

Our state's highway infrastructure represents a substantial investment of $44 billion, with $24 billion in asphalt and concrete. It's vital that we prioritize the preservation and timely maintenance of not just highways, but also parking lots, city streets and other critical surfaces. A proactive and thoughtful approach to asphalt maintenance and preservation ensures that we effectively protect our assets, allowing us to continue investing in essential new projects.

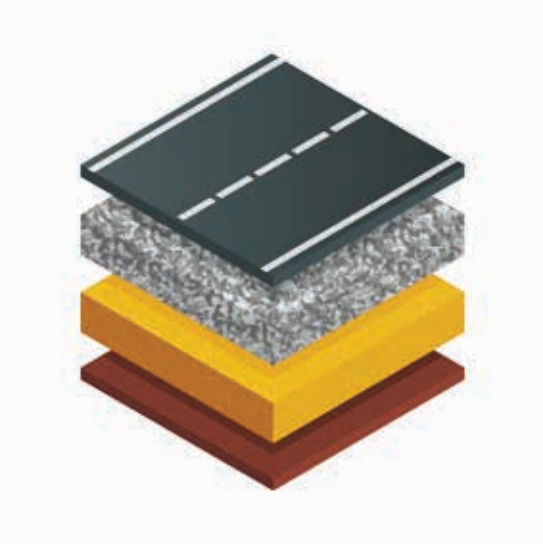
Utah's extreme temperature variations take a significant toll on our pavements, making it imperative that we focus on caring for the foundations of our roads and public spaces. UAPA is fortunate to have a dedicated community of professionals in the asphalt industry who are committed to this cause.

As an association, we aim to provide support, technical expertise and resources to help maintain the integrity of our infrastructure across the state of Utah.

Thank you for your attention to this important initiative, and we look forward to any feedback on this resource guide that you may have.

Sincerely,
Rick W. Johnson
UAPA Executive Director
rickwjohnson@utahasphalt.org

# INTRODUCTION



An asphalt concrete pavement section typically consists of three primary layers over native subgrade soil:

1. Surface course (asphalt concrete pavement).
2. Base course (engineered roadbase).
3. Subbase course (granular soil).

These layers work together to support vehicular traffic. They are referred to as a flexible pavement section because they have the ability to resist cracking while deflect under traffic loads and expanding and contracting with temperature changes. However, even the best-designed and best-constructed pavement sections require maintenance.

Many factors can lead to pavement distresses. They can be related to the pavement section itself (design or workmanship issues), the underlying native subgrade soil, environmental effects such as sun and water, physical damage such as cuts to install utilities, settling utility trenches, unexpected traffic loading, frost heave (expansion of wet fine-grained soil that freezes) or just the passage of time that leads to the asphalt becoming more brittle and years of traffic loading. Identifying the cause of distress helps make good use of money spent on treatments applied to address them.

Since some distresses in asphalt stem from the design and construction of the pavement section, effective maintenance begins with effective design and construction. Best practices include the following:

## DESIGN BEST PRACTICES

1. Establish pavement mix design requirements.
2. Review the pavement mix design to verify that it meets your requirements.
3. Establish pavement section design requirements.
4. Identify the characteristics of soil that will be under the pavement through a sub-surface investigation.
5. Identify expected traffic loading on the pavement.
6. Review the pavement section design and make sure the design on the construction drawings matches it.
7. Establish construction tolerances and compaction requirements based upon local standards.

## CONSTRUCTION BEST PRACTICES

1. Require submittals of materials that will make up the pavement section and verify that they match the materials in the mix and pavement section design.
2. Perform inspection of pavement section construction and follow the established construction standards.
3. Verify that the subgrade material is firm and unyielding under heavy loads and require replacement of it if it isn't stable.
4. Verify thickness of all layers of the pavement section.
5. Test compaction of all layers of the pavement section.
6. Seal asphalt to inhibit the loss of volatile compounds from the binder and to protect it from damage from ultraviolet rays, water and road salts.

## PURPOSE

The most cost-effective way to manage pavement is to keep good roads good. This requires preserving the condition of pavement as long as possible by protecting it from damage. However, as the pavement ages, signs of distress

begin to appear. Treating distresses before they lead to bigger problems is the most cost-effective way to maintain pavement. That means using the right treatment at the right time at the right place.

The purpose of this document is to provide technical guidance on which treatments are appropriate for different types of distresses and for different degrees of distress. The following terms have the associated meanings:

- **Recommended:** These treatments are appropriate for the type and severity of a distress.
- **Not Recommended:** These treatments are not appropriate for the type and severity of a distress.
- **Feasible:** These treatments are acceptable but not the best choice, either because they don't fully address the problem or because they go beyond what is needed to address the problem.

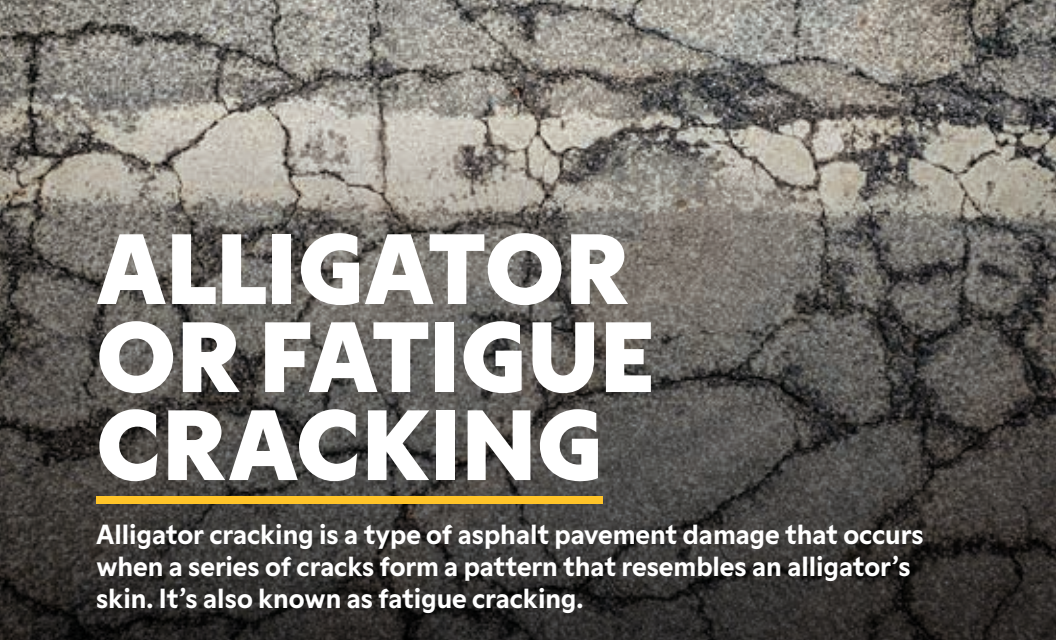
In some instances, multiple treatments can be effectively used together. For instance, crack filling and spot repairs might be used in conjunction with another treatment. There may be causes of pavement distress that require correction, such as utility trench settling or correcting drainage problems.

In some cases of severe distress, the condition of pavement may be so deteriorated that preservation and maintenance treatments will not restore the pavement in a meaningful way. In such cases, pavement replacement is necessary. If the cause of the deterioration is related to the pavement section or subgrade conditions, full reconstruction may be necessary. Pavement replacement and reconstruction is beyond the scope of this guide.

Each case is different, we recommend that you speak with an expert as to your unique situation and possible treatment options.

Best practice is to use the right treatment at the right time, at the price point providing the best treatment outcome. Life expectancy of treatments will vary depending on many factors, and UAPA recommends that life expectancy be a point of discussion with any vendor chosen.

# TABLE OF CONTENTS



# ALLIGATOR OR FATIGUE CRACKING

**Alligator cracking is a type of asphalt pavement damage that occurs when a series of cracks form a pattern that resembles an alligator's skin. It's also known as fatigue cracking.**

Alligator cracking is caused by issues with the soil under the pavement section in areas subject to traffic loading, including:

- Areas of soft, localized, saturated, fine-grained subgrade soil, possibly made worse by inadequate drainage.
- The pavement section may not be thick enough to support traffic loads on the native subgrade soil.
- Water seeping into cracks in the pavement, further weakening the subgrade and accelerating cracking.

To prevent alligator cracking, you can:

- Follow design and construction best practices.
- Prevent the puddling of water on asphalt or at the edge of asphalt.
- Fill cracks when they appear before they grow and let water more get under the asphalt.
- Maintain a surface treatment on the asphalt to resist cracking and prevent the intrusion of water under the asphalt.

Tips on responding to alligator cracking:

- Sealing cracks soon after they appear may slow the progress of alligator cracking.
- Since the cause is the combination of fine-grained soils and saturation of it is the cause of the problem, either the soil needs to be replaced or the source of water has to be eliminated to resolve the problem. If the source of water is not from the surface, no surface treatment will be a permanent solution.

| Preservation Treatments | Severity of Alligator or Fatigue Cracking | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Hot Pour Mastic/Patch** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Spray Applied Preservation** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Seal Coat** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Fog Seal/ Rejuvenator** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Sand Seal** | RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **Scrub Seal** | RECOMMENDED | FEASIBLE | FEASIBLE |
| **Spot Repair** | FEASIBLE | RECOMMENDED | RECOMMENDED |
| **Slurry Seal** | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |
| **Chip Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Micro-Surfacing** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Cape Seal** | FEASIBLE | FEASIBLE | FEASIBLE |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Hot In-Place Recycling (HIR)** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Bonded Wearing Course (BWC)** (Less than 1") | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Ultra-Thin HMA** (0.5" - 1.0") | FEASIBLE | FEASIBLE | NOT RECOMMENDED |

**Recommended:** These treatments are appropriate for the type and severity of a distress. However, it is important to confer with a professional about your existing conditions. (See list of contractors in the back of this booklet.)
**Not Recommended:** These treatments are not appropriate for the type and severity of a distress.
**Feasible:** These treatments are acceptable but not the best choice, either because they don't fully address the problem or because they go beyond what is needed to address the problem.

# BLOCK CRACKING

**Block cracking is a type of asphalt pavement damage that appears as a network of large, rectangular or square-shaped cracks.**

Block cracking is caused by shrinkage of the asphalt and its inability to resist thermal expansion and contraction without cracking. It may be related to:

- Loss of volatile compounds in the binder over time.
- The binder grade used in the asphalt mix design may not have been appropriate for temperature variations in the environment.
- An error in design or batching the asphalt may have resulted in not having enough binder for the aggregate used.

To prevent block cracking, you can:

- Follow design and construction best practices.
- Maintain a surface treatment on the asphalt to preserve its flexibility.

Tips on responding to block cracking:

- If the cracks are working cracks (defined by thermal expansion/contraction of more than 0.1”), consider routing the cracks before sealing them to allow for better adhesion of the sealer material.
- Fill cracks soon after they appear to prevent the intrusion of water under the asphalt.
- Milling the upper portion of the asphalt (which will have lost much of its volatile binder compounds) prior to placement of a new HMA layer can improve performance.

| Preservation Treatments | Severity of Block Cracking | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Hot Pour Mastic/Patch** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Spray Applied Preservation** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Seal Coat** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Fog Seal/ Rejuvenator** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Sand Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Scrub Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Spot Repair** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Slurry Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Chip Seal** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Micro-Surfacing** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Cape Seal** | FEASIBLE | FEASIBLE | FEASIBLE |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | FEASIBLE | RECOMMENDED | FEASIBLE |
| **Hot In-Place Recycling (HIR)** | FEASIBLE | RECOMMENDED | FEASIBLE |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | FEASIBLE | RECOMMENDED | RECOMMENDED |
| **Bonded Wearing Course (BWC)** (Less than 1") | FEASIBLE | FEASIBLE | FEASIBLE |
| **Ultra-Thin HMA** (0.5" - 1.0") | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |

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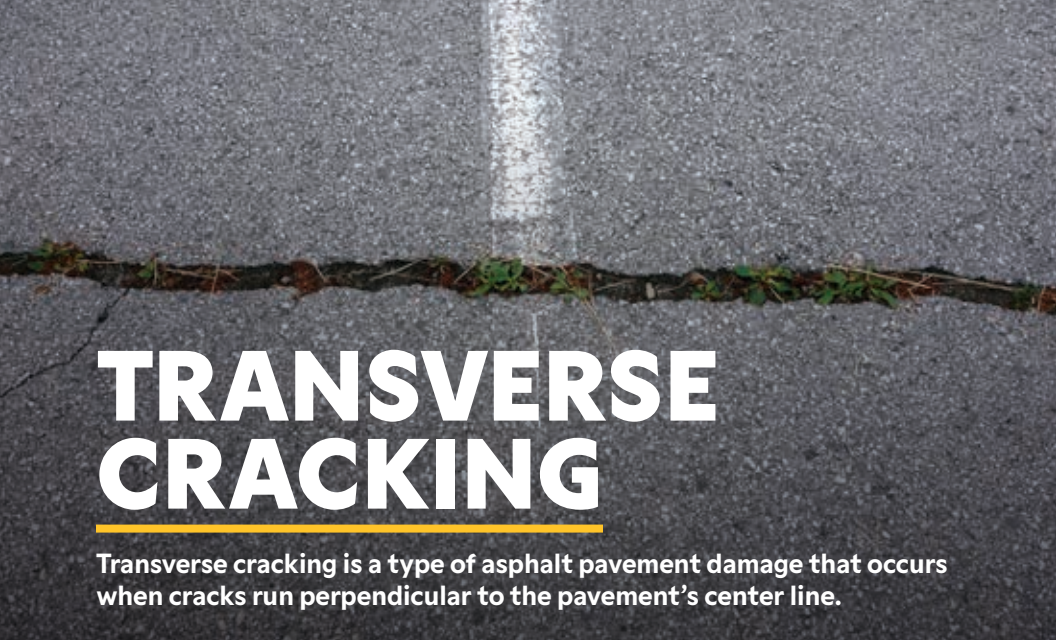

# TRANSVERSE CRACKING

**Transverse cracking is a type of asphalt pavement damage that occurs when cracks run perpendicular to the pavement's center line.**

Transverse cracking is primarily caused by shrinkage of the asphalt and its inability to resist thermal expansion and contraction without cracking. It may be related to:

- Loss of volatile compounds in the binder over time.
- A high content of lime and fly ash, which increases drying and temperature shrinkage deformation.
- Freshly laid hot asphalt meeting cold air.
- Reflection from underlying layers.

To prevent transverse cracking, you can:

- Follow design and construction best practices.
- Avoid laying asphalt in cold weather.
- Maintain a surface treatment on the asphalt to preserve its flexibility.

Tips on responding to block cracking:

- If the cracks are working cracks (defined by thermal expansion/contraction of more than 0.1"), consider routing the cracks before sealing them to allow for better adhesion of the sealer material.
- Fill cracks soon after they appear to prevent the intrusion of water under the asphalt.
- Milling the upper portion of the asphalt to the depth of the crack (which will have lost much of its volatile binder compounds) prior to placement of a new HMA layer can improve performance, especially in cases of severe transverse cracking.

| Preservation Treatments | Severity of Transverse Cracking | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Hot Pour Mastic/Patch** | FEASIBLE | RECOMMENDED | RECOMMENDED |
| **Spray Applied Preservation** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Seal Coat** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Fog Seal/ Rejuvenator** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Sand Seal** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Scrub Seal** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Spot Repair** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Slurry Seal** | RECOMMENDED | FEASIBLE | FEASIBLE |
| **Chip Seal** | RECOMMENDED | FEASIBLE | FEASIBLE |
| **Micro-Surfacing** | RECOMMENDED | FEASIBLE | FEASIBLE |
| **Cape Seal** | RECOMMENDED | FEASIBLE | FEASIBLE |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | FEASIBLE | RECOMMENDED | FEASIBLE |
| **Hot In-Place Recycling (HIR)** | FEASIBLE | RECOMMENDED | FEASIBLE |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | FEASIBLE | FEASIBLE | RECOMMENDED |
| **Bonded Wearing Course (BWC)** (Less than 1") | FEASIBLE | FEASIBLE | FEASIBLE |
| **Ultra-Thin HMA** (0.5" - 1.0") | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |

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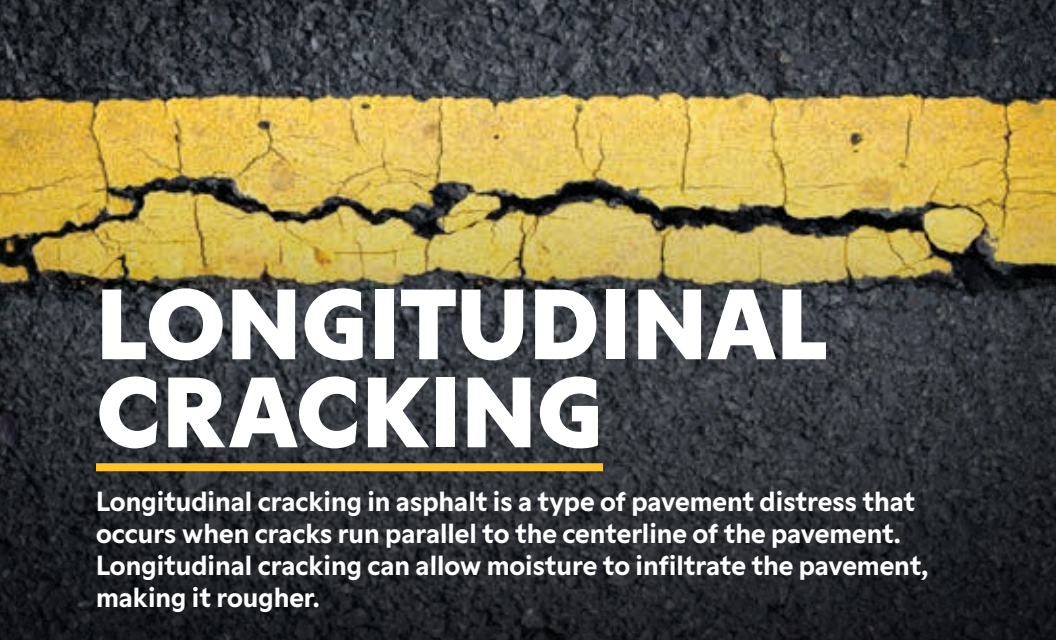

# LONGITUDINAL CRACKING

**Longitudinal cracking in asphalt is a type of pavement distress that occurs when cracks run parallel to the centerline of the pavement. Longitudinal cracking can allow moisture to infiltrate the pavement, making it rougher.**

Longitudinal cracking is caused by issues related to linear features. It may be related to:

- Inadequate compaction between adjacent passes of asphalt construction.
- Inability of the pavement section to support loads in the wheel path.
- Frost heave in the wheel path resulting from heavy traffic and moist fine-grained soils within the frost zone.
- Inadequate compaction and subsequent settling of utility trenches.
- Reflection from underlying layers.
- Thermal shrinkage.
- Loss of volatile compounds in the binder over time.
- Poor joint construction.

To prevent longitudinal cracking, you can:

- Using true warm mix where the temperature is reduced during application instead of hot mix asphalt.
- Maintain a surface treatment on the asphalt to preserve its flexibility.

Tips on responding to longitudinal cracking:

- Fill cracks soon after they appear to prevent the intrusion of water under the asphalt.
- If the cause of longitudinal cracking is related to conditions below the asphalt layer, correction of these conditions will be required for a permanent solution to the problem.

| Preservation Treatments | Severity of Longitudinal Cracking | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Hot Pour Mastic/Patch** | FEASIBLE | RECOMMENDED | RECOMMENDED |
| **Spray Applied Preservation** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Seal Coat** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Fog Seal/ Rejuvenator** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Sand Seal** | FEASIBLE | FEASIBLE/ RECOMMENDED* | NOT RECOMMENDED |
| **Scrub Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Spot Repair** | FEASIBLE | FEASIBLE/ RECOMMENDED* | FEASIBLE/ RECOMMENDED* |
| **Slurry Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Chip Seal** | RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **Micro-Surfacing** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Cape Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Hot In-Place Recycling (HIR)** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | FEASIBLE | FEASIBLE | FEASIBLE |
| **Bonded Wearing Course (BWC)** (Less than 1") | FEASIBLE | FEASIBLE | FEASIBLE |
| **Ultra-Thin HMA** (0.5" - 1.0") | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |

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**Depending on the cause of the distress.*

# REFLECTIVE CRACKING

**Reflective cracking is a type of asphalt pavement failure that occurs when cracks appear in a flexible overlay over an existing crack or joint in the underlying surface.**

Reflective cracking occurs when a new layer of asphalt is placed over an old layer of asphalt, there is movement (such as thermal expansion/contraction) of the asphalt, and cracks develop at weak points in the pavement section, which is where there are already cracks in the old layer of asphalt.

- The same effect can occur when asphalt is placed over joints or edges of concrete.
- The effect is exacerbated as asphalt hardens over time.

To prevent reflective cracking, you can:

- Use thicker overlays to help dissipate stresses and reduce the severity of cracks.
- Rubblize or heavily fracture concrete pavement before overlaying it with asphalt pavement.
- Use geogrids, geocomposites and geogrid composites between the old asphalt and the overlay to delay the onset of reflective cracking and reduce the magnitude and severity of cracks.
- In warm climates, incorporating fabric under a chip seal can improve the life of a chip seal by 50-70%.

Tips on responding to reflective cracking:

- Fill cracks soon after they appear.
- New asphalt can be saw-cut to form a clean opening and filled with mastic to control the location of cracking.

| Preservation Treatments | Severity of Reflective Cracking | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Hot Pour Mastic/Patch** | FEASIBLE | RECOMMENDED | RECOMMENDED |
| **Spray Applied Preservation** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Seal Coat** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Fog Seal/ Rejuvenator** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Sand Seal** | RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **Scrub Seal** | RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **Spot Repair** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Slurry Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Chip Seal** | RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **Micro-Surfacing** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Cape Seal** | RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | RECOMMENDED | RECOMMENDED | FEASIBLE |
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# RUTTING AND SHOVING

**Rutting and shoving are permanent vertical or longitudinal displacements of the asphalt.**

Rutting is the permanent depression of asphalt in the wheel path. It results from heavy traffic loading and insufficient strength of the pavement section, resulting in deformation of the asphalt surface or underlying layers. Weak asphalt mixtures, insufficient pavement section thickness, or inadequate compaction can lead to rutting. Rutting can also occur when there is too much asphalt binder in the HMA mix, signifying a problem with the mix design.

Shoving is the formation of ripples or small mounds in the asphalt surface. Shoving is also known as washboarding. Shoving can be caused by excess asphalt, too much fine aggregate, rounded aggregate, too soft an asphalt or a weak granular base. Shoving is most likely to occur where heavy vehicles frequently decelerate rapidly.

To prevent rutting and shoving, you can:

- Follow design and construction best practices.
- Include polymeric additives in the binder.
- Use a stiffer binder to increase resilience of the asphalt layer.

Tips on responding to rutting and shoving:

- If rutting is caused by failure below the asphalt layer, surface repairs won't address the underlying cause and will not be a permanent solution to the problem.
- When replacing asphalt experiencing shoving with a mix having a stiffer binder, be aware that mixes with stiffer binders are more susceptible to cracking.

| Preservation Treatments | Severity of Rutting and Shoving | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Hot Pour Mastic/Patch** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Spray Applied Preservation** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Seal Coat** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Fog Seal/ Rejuvenator** | RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Sand Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Scrub Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Spot Repair** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Slurry Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Chip Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Micro-Surfacing** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Cape Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Hot In-Place Recycling (HIR)** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
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**Feasible:** These treatments are acceptable but not the best choice, either because they don't fully address the problem or because they go beyond what is needed to address the problem.

# ASPHALT RAVELING

**Asphalt raveling is the process by which the top layer of asphalt breaks down, exposing the aggregate materials underneath, such as gravel, sand and crushed stone, and making a road surface rough and pitted. It can also compromise the foundation of the asphalt, making the surface more vulnerable to further deterioration. Raveling is one of the most common issues with driveways and parking lots, but it's also one of the most easily repairable.**

Raveling can be caused by problems related to the mix design, construction, or environmental effects, including:

- Insufficient binder in the asphalt mix.
- Asphalt being mixed with dirty aggregate, to which the binder in the mix cannot properly adhere.
- Segregation of the aggregate in the mix prior to being laid.
- Inadequate compaction of the asphalt layer.
- Breakdown of the binder over time or due to exposure to solvents (such as gasoline or engine oil) and erosion of fine aggregate.

To prevent raveling, you can:

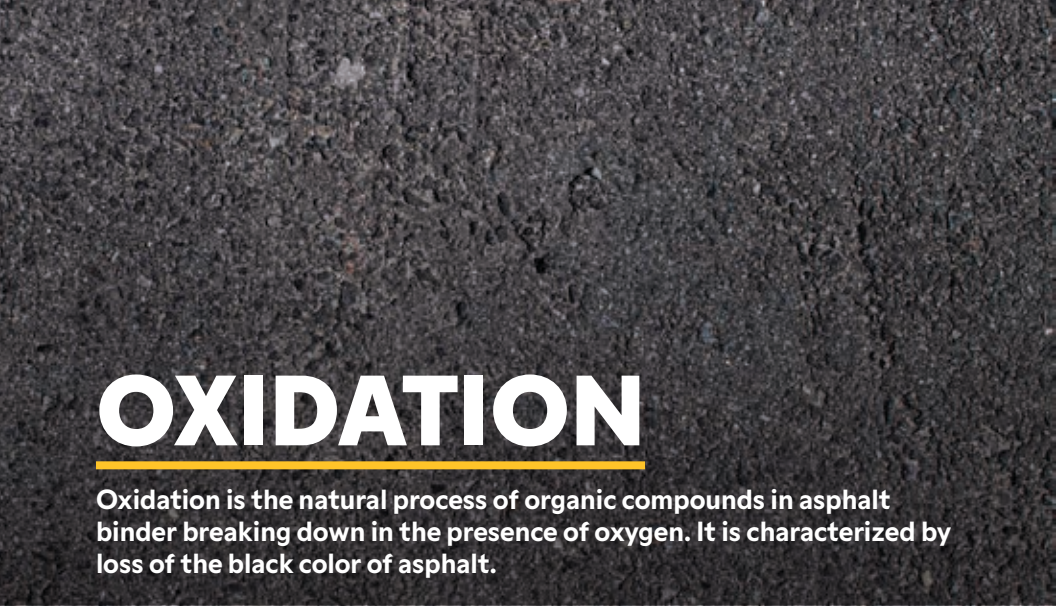
- Follow design and construction best practices.
- Prevent exposure to solvents that would break down the binder in asphalt pavement.

Tips on responding to raveling:

- Before putting a treatment over raveled asphalt, clean all loose pieces of asphalt and aggregate from the old asphalt.

| Preservation Treatments | Severity of Asphalt Raveling | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Hot Pour Mastic/Patch** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Spray Applied Preservation** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Seal Coat** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Fog Seal/ Rejuvenator** | RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **Sand Seal** | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |
| **Scrub Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Spot Repair** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Slurry Seal** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Chip Seal** | RECOMMENDED | FEASIBLE | FEASIBLE |
| **Micro-Surfacing** | RECOMMENDED | FEASIBLE | FEASIBLE |
| **Cape Seal** | RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | FEASIBLE | RECOMMENDED | RECOMMENDED |
| **Hot In-Place Recycling (HIR)** | FEASIBLE | RECOMMENDED | RECOMMENDED |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | FEASIBLE | FEASIBLE | FEASIBLE |
| **Bonded Wearing Course (BWC)** (Less than 1") | FEASIBLE | FEASIBLE | FEASIBLE |
| **Ultra-Thin HMA** (0.5" - 1.0") | FEASIBLE | FEASIBLE | FEASIBLE |

**Recommended:** These treatments are appropriate for the type and severity of a distress. However, it is important to confer with a professional about your existing conditions. (See list of contractors in the back of this booklet.)
**Not Recommended:** These treatments are not appropriate for the type and severity of a distress.
**Feasible:** These treatments are acceptable but not the best choice, either because they don't fully address the problem or because they go beyond what is needed to address the problem.



# OXIDATION

**Oxidation is the natural process of organic compounds in asphalt binder breaking down in the presence of oxygen. It is characterized by loss of the black color of asphalt.**

Oxidation is a natural process that starts to occur the moment asphalt is mixed. Asphalt binders are made of organic molecules that react with oxygen in the air. This reaction is similar to how an apple or banana browns when exposed to air. As oxidation progresses, asphalt becomes more susceptible to cracking. These factors affect the rate of oxidation:

- The rate of oxidation doubles for every 10°C increase in temperature.
- The more oxygen that's available to react with the asphalt binder, and the longer it is available, the faster the binder will oxidize.
- Sunlight accelerates the oxidation of asphalt binders.

Oxidation can be slowed down by:

- Using true warm mix where the temperature is reduced during application instead of hot mix asphalt.
- Applying a surface treatment layer over the asphalt surface to protect it from sunlight and isolate it from oxygen. This is more effective when done early in the lift of the asphalt.

Tips on responding to oxidation:

- Most surface treatments won't restore the flexibility of oxidized asphalt pavement, but they will inhibit further oxidation.
- A rejuvenator should only be used on HMA that has at least 5% air voids. If voids are less than 5%, the rejuvenator may fill the voids, resulting in an unstable mix.
- Rejuvenator will penetrate deeper in the asphalt if best applied in warm weather (over 70°F).

| Preservation Treatments | Severity of Oxidation | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Hot Pour Mastic/Patch** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Spray Applied Preservation** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Seal Coat** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Fog Seal/ Rejuvenator** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Sand Seal** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Scrub Seal** | RECOMMENDED | RECOMMENDED | FEASIBLE |
| **Spot Repair** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Slurry Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Chip Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Micro-Surfacing** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Cape Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Hot In-Place Recycling (HIR)** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | FEASIBLE | FEASIBLE | FEASIBLE |
| **Bonded Wearing Course (BWC)** (Less than 1") | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Ultra-Thin HMA** (0.5" - 1.0") | RECOMMENDED | RECOMMENDED | FEASIBLE |

**Recommended:** These treatments are appropriate for the type and severity of a distress. However, it is important to confer with a professional about your existing conditions. (See list of contractors in the back of this booklet.)
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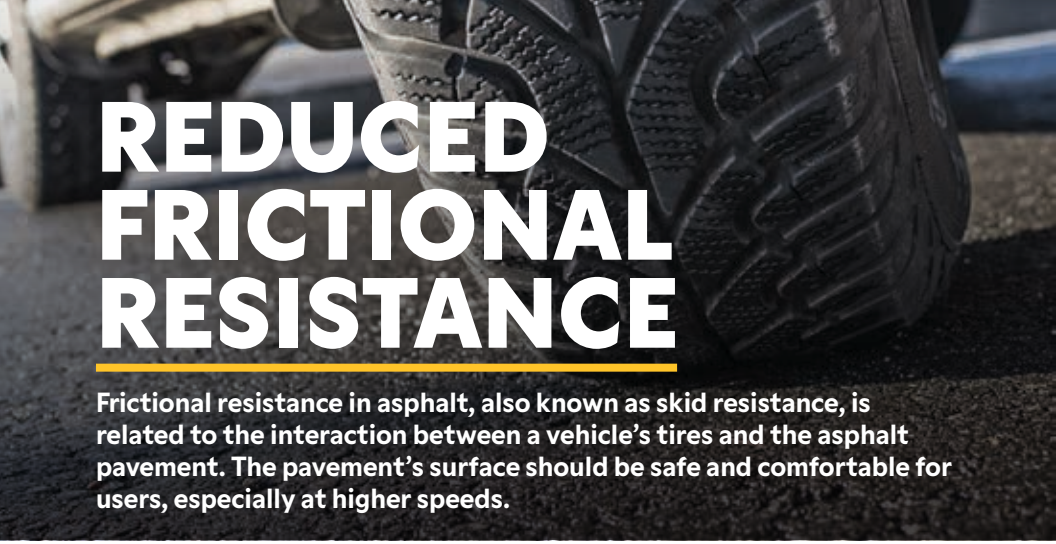


# REDUCED FRICTIONAL RESISTANCE

**Frictional resistance in asphalt, also known as skid resistance, is related to the interaction between a vehicle's tires and the asphalt pavement. The pavement's surface should be safe and comfortable for users, especially at higher speeds.**

Frictional resistance is a measure of gravity's ability to apply frictional force between asphalt surfaces and vehicle tires. This force is necessary for vehicles to accelerate and decelerate. These factors reduce frictional resistance:

- The pavement's macrotexture — this is roughness related to variations in the height of individual pieces of aggregate and the binder between them.
- The pavement's microtexture — this is the roughness of the surface of the binder and individual pieces of aggregate that tires contact.
- Greater macrotexture and microtexture both correlate with greater frictional resistance.
- Microtexture is reduced from the wear of repeated vehicle contact with the pavement.
- Vehicle wear can also reduce the macrotexture if no additional aggregate is placed on the road surface for an extended period of time.
- Bleeding (excessive binder at the surface of the pavement) reduces the frictional resistance.

There are other factors that will influence the frictional force between the road and tires, such as the quality of tires and the presence of water or ice. While very important, they are not measures of the inherent friction resistance of the asphalt pavement.

Undesirably low frictional resistance can be prevented by:

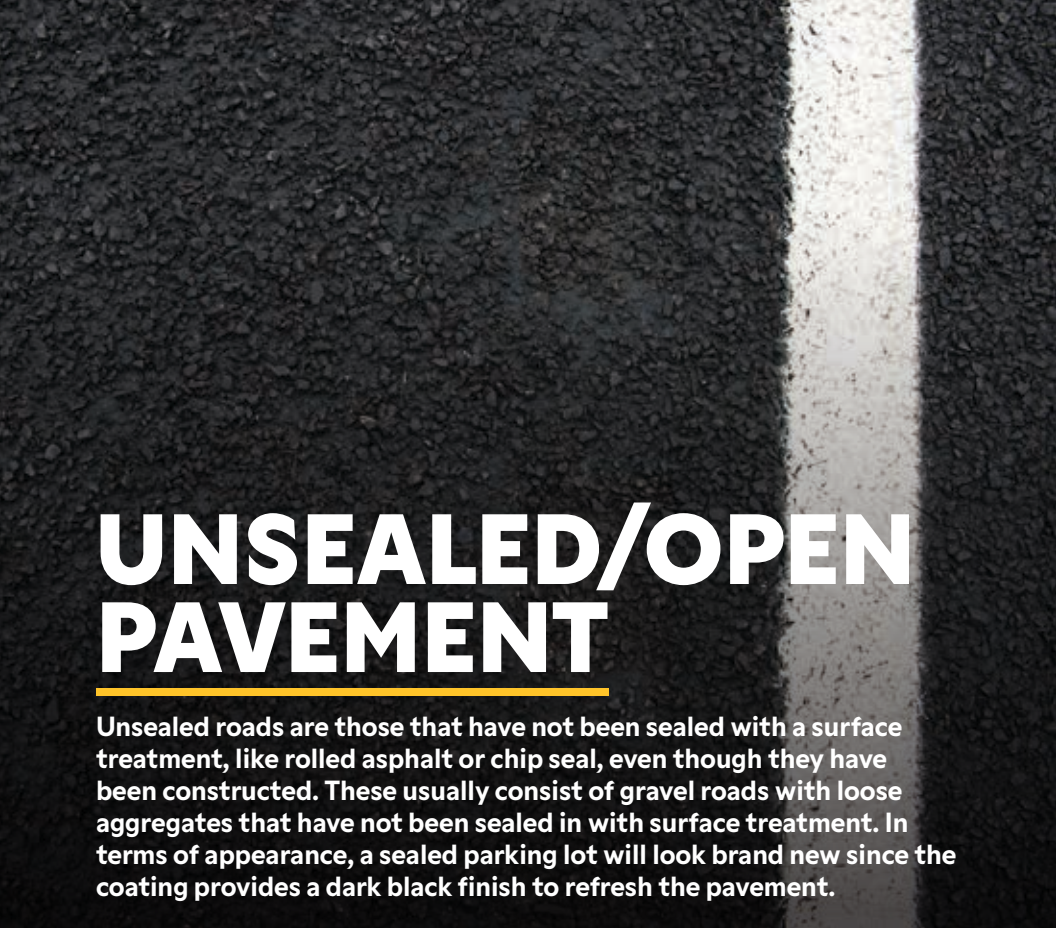
- Using design and construction best management practices.
- Applying a treatment with a texture that will restore good frictional resistance.

Tips on responding to reduced frictional resistance:

- Refer to the page on bleeding (page 28) if there is excessive binder at the surface of the pavement.

| Preservation Treatments | Severity of Frictional Resistance | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Hot Pour Mastic/Patch** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Spray Applied Preservation** | RECOMMENDED | FEASIBLE/ RECOMMENDED* | FEASIBLE/ RECOMMENDED* |
| **Seal Coat** | RECOMMENDED | FEASIBLE/ RECOMMENDED* | FEASIBLE/ RECOMMENDED* |
| **Fog Seal/ Rejuvenator** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Sand Seal** | FEASIBLE | RECOMMENDED | RECOMMENDED |
| **Scrub Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Spot Repair** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Slurry Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Chip Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Micro-Surfacing** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Cape Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Hot In-Place Recycling (HIR)** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | FEASIBLE | FEASIBLE | FEASIBLE |
| **Bonded Wearing Course (BWC)** (Less than 1") | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Ultra-Thin HMA** (0.5" - 1.0") | RECOMMENDED | RECOMMENDED | RECOMMENDED |

**Recommended:** These treatments are appropriate for the type and severity of a distress. However, it is important to confer with a professional about your existing conditions. (See list of contractors in the back of this booklet.)
**Not Recommended:** These treatments are not appropriate for the type and severity of a distress.
**Feasible:** These treatments are acceptable but not the best choice, either because they don't fully address the problem or because they go beyond what is needed to address the problem.
**Depending on the texture of the treatment.*



# UNSEALED/OPEN PAVEMENT

**Unsealed roads are those that have not been sealed with a surface treatment, like rolled asphalt or chip seal, even though they have been constructed. These usually consist of gravel roads with loose aggregates that have not been sealed in with surface treatment. In terms of appearance, a sealed parking lot will look brand new since the coating provides a dark black finish to refresh the pavement.**

Permeable or open grid paving consists of standard concrete blocks, which have a large percentage of the surface area that is open or penetrable. The open area allows for water to penetrate the paving as opposed to normal paving (clay, concrete asphalt), which assists water running off the paving into stormwater systems.

| Preservation Treatments | Severity of Unsealed/Open Pavement | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Hot Pour Mastic/Patch** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Spray Applied Preservation** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Seal Coat** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Fog Seal/ Rejuvenator** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Sand Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Scrub Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Spot Repair** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Slurry Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Chip Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Micro-Surfacing** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Cape Seal** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Hot In-Place Recycling (HIR)** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Bonded Wearing Course (BWC)** (Less than 1") | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Ultra-Thin HMA** (0.5" - 1.0") | RECOMMENDED | RECOMMENDED | RECOMMENDED |

**Recommended:** These treatments are appropriate for the type and severity of a distress. However, it is important to confer with a professional about your existing conditions. (See list of contractors in the back of this booklet.)
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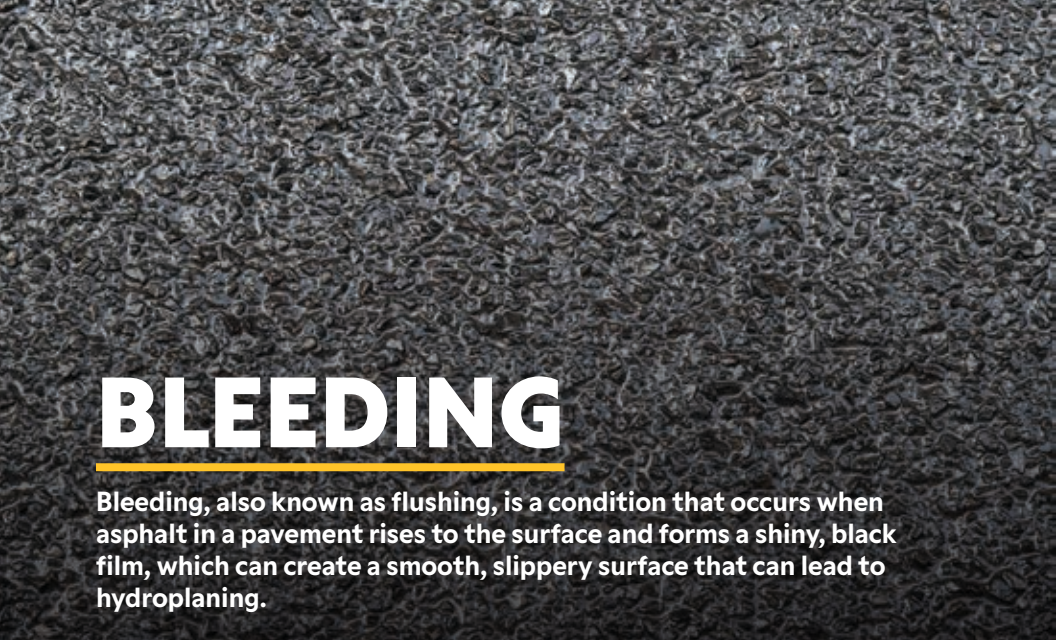

# BLEEDING

**Bleeding, also known as flushing, is a condition that occurs when asphalt in a pavement rises to the surface and forms a shiny, black film, which can create a smooth, slippery surface that can lead to hydroplaning.**

Bleeding can be caused by a number of factors, including:

- Too much asphalt binder in the mix, or the wrong type of asphalt.
- Poor construction practices, such as an improperly constructed seal coat or a prime coat that's too heavy.
- Hot weather or traffic compaction can cause the asphalt binder to fill voids in the pavement and expand onto the surface.

Bleeding can be prevented by:

- Ensuring the asphalt is not too porous.
- Using a well-drained aggregate.
- Incorporating adequate drainage into the pavement design.
- Using polymer-modified or other binders to improve surface treatment performance.
- Addressing best-practice factors like traffic loads and environmental conditions.

Tips to respond to bleeding:

- Minor bleeding may be correctable by using coarse sand to absorb excess binder.
- Major bleeding may require removing excess binder by milling and replacing the surface of the asphalt pavement.

| Preservation Treatments | Severity of Bleeding | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Hot Pour Mastic/Patch** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Spray Applied Preservation** | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |
| **Seal Coat** | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |
| **Fog Seal/ Rejuvenator** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Sand Seal** | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |
| **Scrub Seal** | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |
| **Spot Repair** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Slurry Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Chip Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Micro-Surfacing** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Cape Seal** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Hot In-Place Recycling (HIR)** | FEASIBLE | FEASIBLE | FEASIBLE |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | FEASIBLE | FEASIBLE | RECOMMENDED |
| **Bonded Wearing Course (BWC)** (Less than 1") | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Ultra-Thin HMA** (0.5" - 1.0") | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |

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# POTHOLES

**Potholes are pot-shaped holes in the asphalt pavement that form for various reasons. They will expand if not addressed.**

Potholes are usually caused by:

- Water that seeps into the soil below the road surface and freezes when temperatures drop, causing the ground to expand and push the pavement up. When the temperatures rise, the ground returns to normal, but the pavement remains raised and creates a gap.
- The weight of vehicles driving over the gap causes the pavement to crack and fall into the hollow space. The more traffic a roadway sees, the more impact the pavement is subject to.

Potholes can be prevented by:

- Sealing cracks as soon as you notice them to prevent water from seeping into the asphalt and causing potholes. For small cracks, you can use a liquid cold-pour crack filler or find an asphalt contractor to fix them with a hot-pour rubberized crack filler.
- Resealing your asphalt every three to five years to protect it from sun and heat damage, reducing the development of pot holes.
- Overlays, which are a more intensive treatment that involves constructing a layer of compacted asphalt to seal the surface.
- Reconstruction, which involves digging up and rebuilding the damaged roadbed.

| Preservation Treatments | Severity of Potholes | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Hot Pour Mastic/Patch** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Spray Applied Preservation** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Seal Coat** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Fog Seal/ Rejuvenator** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Sand Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Scrub Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Spot Repair** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Slurry Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Chip Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Micro-Surfacing** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Cape Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | RECOMMENDED | FEASIBLE | FEASIBLE |
| **Hot In-Place Recycling (HIR)** | RECOMMENDED | FEASIBLE | FEASIBLE |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **Bonded Wearing Course (BWC)** (Less than 1") | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |
| **Ultra-Thin HMA** (0.5" - 1.0") | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |

**Recommended:** These treatments are appropriate for the type and severity of a distress. However, it is important to confer with a professional about your existing conditions. (See list of contractors in the back of this booklet.)
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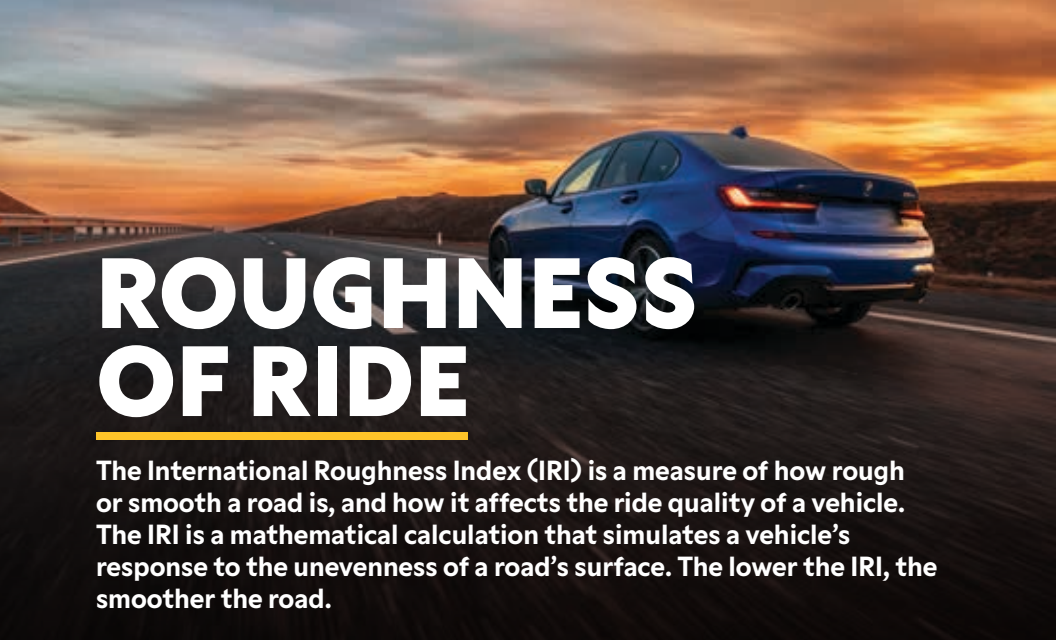

# ROUGHNESS OF RIDE

**The International Roughness Index (IRI) is a measure of how rough or smooth a road is, and how it affects the ride quality of a vehicle. The IRI is a mathematical calculation that simulates a vehicle's response to the unevenness of a road's surface. The lower the IRI, the smoother the road.**

The IRI is calculated using a profiler, a device that measures the distance between a vehicle and the road surface. The IRI is reported in units of inches per mile (in/mi), meters per kilometer (m/km) or millimeters per meter (mm/m).

Roughness affects vehicle delay costs, fuel consumption and maintenance costs. Studies have shown that smoother roads can lead to better fuel economy.

A rough ride on asphalt can be caused by a number of factors, including:

- Deeper problems in the pavement, such as rutting, upheavals or depressions.
- Traffic loading can cause pavement to deteriorate.
- Weather conditions like rain, snow, frost and storms can contribute to pavement roughness.
- The type of aggregate used in the asphalt mix can affect the surface texture.
- Poor construction techniques can lead to pavement settling and depressions.
- An unstable subgrade can cause pavement to settle and depressions to form.
- Insufficient pavement thickness can lead to problems.
- Improper curing and finishing of concrete can cause disintegration.

The roughness of asphalt can be prevented by:

- Considering pavement design.
- Maintaining and rehabilitating pavement timely.
- Paying attention to test sections.

| Preservation Treatments | Severity of Roughness of Ride | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Hot Pour Mastic/Patch** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Spray Applied Preservation** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Seal Coat** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Fog Seal/ Rejuvenator** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Sand Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Scrub Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Spot Repair** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Slurry Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Chip Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Micro-Surfacing** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Cape Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | FEASIBLE | RECOMMENDED | RECOMMENDED |
| **Hot In-Place Recycling (HIR)** | FEASIBLE | RECOMMENDED | RECOMMENDED |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Bonded Wearing Course (BWC)** (Less than 1") | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Ultra-Thin HMA** (0.5" - 1.0") | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |

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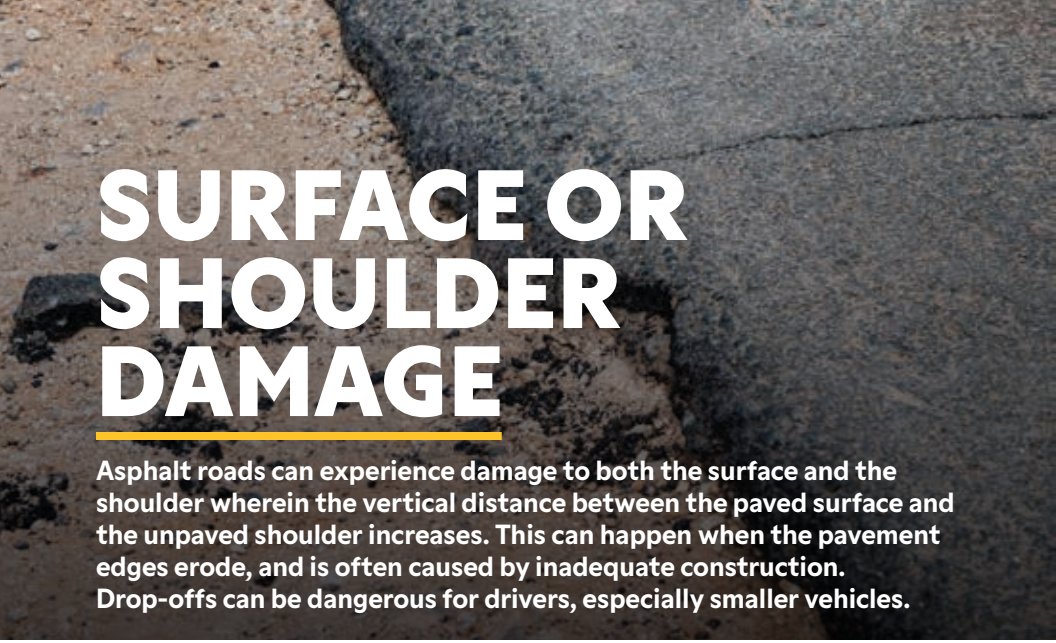

# SURFACE OR SHOULDER DAMAGE

**Asphalt roads can experience damage to both the surface and the shoulder wherein the vertical distance between the paved surface and the unpaved shoulder increases. This can happen when the pavement edges erode, and is often caused by inadequate construction. Drop-offs can be dangerous for drivers, especially smaller vehicles.**

Asphalt can crack in a number of ways, including longitudinal cracks that run parallel to the laydown direction, transverse cracks that run perpendicular and block cracks that look like large rectangles. Cracks can be caused by a number of things, including poor joint structure, heavy traffic and temperature cycles.

Asphalt can also experience distortion, disintegration, skidding hazards and surface treatment distresses.

Some common causes of asphalt damage include:

- Poor drainage.
- Heavy vehicles driving too close to the edge of the road.
- Climate influences.
- Materials quality problems.
- Construction deficiencies.
- Utility cuts.

## PREVENTATIVE MEASURES

- In instances where there is a 2" drop from the edge of the asphalt to the shoulder, it is considered an edge drop. It is important to expedite addressing this as it is a safety issue.
- To protect and help support the edges of the new pavement, best practice is to install stone, gravel or topsoil around its perimeter.
- Avoid leaks or spills of gasoline, fuel oil, lubricants and other petroleum-based products on the pavement.

| Preservation Treatments | Severity of Surface or Shoulder Damage | | |
|---|---|---|---|
| | **LOW** (Very Mild) | **MEDIUM** (Noticeable, but Not Extensive) | **HIGH** (Extensive in Most Locations) |
| **Crack Sealing** | FEASIBLE | FEASIBLE | NOT RECOMMENDED |
| **Hot Pour Mastic/Patch** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Spray Applied Preservation** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Seal Coat** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Fog Seal/ Rejuvenator** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Sand Seal** | NOT RECOMMENDED | RECOMMENDED | NOT RECOMMENDED |
| **Scrub Seal** | NOT RECOMMENDED | RECOMMENDED | NOT RECOMMENDED |
| **Spot Repair** | RECOMMENDED | RECOMMENDED | RECOMMENDED |
| **Slurry Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Chip Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Micro-Surfacing** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **Cape Seal** | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |
| **MAINTENANCE AND REHAB OPTIONS** | | | |
| **Cold In-Place Recycling (CIR)** | NOT RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **Hot In-Place Recycling (HIR)** | NOT RECOMMENDED | FEASIBLE | NOT RECOMMENDED |
| **Hot Mix Asphalt (HMA) Overlay** (Less than 2") | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |
| **Bonded Wearing Course (BWC)** (Less than 1") | FEASIBLE | NOT RECOMMENDED | NOT RECOMMENDED |
| **Ultra-Thin HMA** (0.5" - 1.0") | NOT RECOMMENDED | NOT RECOMMENDED | NOT RECOMMENDED |

**Recommended:** These treatments are appropriate for the type and severity of a distress. However, it is important to confer with a professional about your existing conditions. (See list of contractors in the back of this booklet.)
**Not Recommended:** These treatments are not appropriate for the type and severity of a distress.
**Feasible:** These treatments are acceptable but not the best choice, either because they don't fully address the problem or because they go beyond what is needed to address the problem.

# PAVEMENT PRESERVATION TREATMENT MATRIX

| Roadway Condition | Surface/Road Type | Treatment |
|---|---|---|
| **Cracking**<br>**Water Infiltration** | All Types (up to 1.5" wide) | Crack Sealing |
| | All Road Types<br>Wide Crack, Alligatored areas,<br>Potholes and Rutting (1.5" or larger) | Hot Pour<br>Mastic/Patch |
| | Residential Streets, Low Volume<br>Roads, Arterials, Highways | Scrub Seal |
| **Oxidized**<br>**Dry Asphalt**<br>**Raveling** | Residential Streets, Low Volume Roads,<br>Airport Taxiways, Arterials, Highways | Fog Seal |
| | All Types | Rejuvenator |
| | Parking Lots, Driveways, Residential<br>Low Volume, Airport Taxiways | Spray Applied |
| | Parking Lots, Driveways, Residential<br>Low Volume, Airport Taxiways | Seal Coat |
| **Wearing Surface**<br>**Flushing**<br>**Rutting**<br>**Skid Resistance** | Residential Streets, Low Volume<br>Roads, Arterials, Highways | Scrub Seal |
| | Residential Streets, Low/High Volume<br>Roads, Arterials, Highways, Interstates | Chip Seal |
| | Driveways, Parking Lots, Airport<br>Taxiways, Rural Airport Runways,<br>Residential Streets, Low Volume Roads | Slurry Seal |
| | Residential Streets, Low Volume Roads,<br>Arterials, Highways, Interstates | Micro-Surfacing |
| | Residential Streets, Low Volume Roads,<br>Arterials, Highways, Interstates | Cape Seal |
| **MAINTENANCE AND REHAB OPTIONS** | | |
| **Complete Failure of Asphalt**<br>**Base Failure**<br>**Major Rutting**<br>**Extensive Pot Holes** | Highways, Interstates | Cold In-Place<br>Recycling (CIR) |
| | Highways, Interstates | Hot In-Place<br>Recycling (HIR) |
| | All Types | Ultra Thin HMA |
| | All Types | HMA Overlay |
| | Arterials, Highways, Interstates | Bonded Wearing<br>Course (BWC) |

| **Typical Timeframe** | **Average Cost** (per Sq Yard) | **Reason for Application** |
|---|---|---|
| Every 1-2 years | $ | To prevent water infiltration and further cracking. |
| Every 3-5 years | $$ | To seal extensive cracking and alligatored areas. |
| Every 5-7 years | $$ | Mass crack seal, rejuvenate the surface, add a new wearing surface and increase skid resistance. |
| Every 3-5 years | $ | To rejuvenate oxidized asphalt and seal the surface, reducing small raveling. |
| Every 3-5 years | $$ | To rejuvenate oxidized asphalt and seal small surface cracks. |
| Every 5-7 years | $$-$$$ | To protect against oxidative damage seal surface. |
| Every 3-5 years | $$ | To protect against oxidative damage seal surface. |
| Every 5-7 years | $$$$ | Mass crack seal, rejuvenate the surface, add a new wearing surface and increase skid resistance. |
| Every 5-7 years | $$$$ | To provide a new wearing surface, seal roadway and increase skid resistance. |
| Every 5-7 years | $$$ | To provide a new wearing surface, seal minor cracks and increase skid resistance. |
| Every 5-7 years | $$$$ | To provide a new wearing surface, seal roadway, rut filling and improve skid resistance. |
| Every 7-10 years | $$$$$ | Mass crack seal, rejuvenate the surface, add a new wearing surface, rut filling and increase skid resistance. |
| | | |
| Every 10-15 years | | To rehabilitate and reuse existing pavement materials. |
| Every 10-15 years | | To rehabilitate and reuse existing pavement materials. |
| Every 7-10 years | | To provide a new wearing surface and improve ride quality. |
| Every 10-15 years | | To provide a new wearing surface and increase structural capacity. |
| Every 10-15 years | | To provide a durable wearing surface and improve ride quality. |

# TREATMENTS

# Crack Sealing ($)

Crack sealing is a pavement maintenance technique that involves the placement of specialized treatment materials into working cracks to prevent water and incompressible particles from entering and deteriorating the pavement structure. Working cracks are defined as those that show significant movement, typically more than 0.1", due to changes in temperature and pavement movement.

Crack width significantly influences the appropriate sealing method. For narrow cracks (less than 1/4"), routing is recommended prior to sealant injection to enhance adhesion and penetration. Cracks between 1/4" and 1" can typically be sealed effectively with typical hot-pour materials, while cracks exceeding 1" often require more substantial repair methods or materials such as hot-pour mastic.

Here's a step-by-step explanation of the crack-sealing process:

1. **Crack Preparation:** Cracks must be prepared before sealing, which often involves routing to enlarge the crack into a reservoir and cleaning it of debris and moisture. This can be done with brushes, air compressors, hot air lances or other methods.
2. **Material Selection:** The sealant material used for crack sealing is specifically designed to be elastic and capable of expanding and contracting with the pavement's movement. Common materials include hot-applied rubberized asphalt sealants, silicone and pre-formed compression sealants.
3. **Sealant Application:** The selected sealant is then applied into the crack using specialized equipment such as a melter applicator, which heats the sealant to a liquid state before it is poured into the crack.
4. **Finishing:** After the sealant is applied, it may be tooled or squeegeed to promote good bonding with the crack walls and to create a smooth, level finish with the pavement surface.
5. **Curing:** The sealant must cool and cure before the pavement is reopened to traffic. The time required for this can vary depending on the sealant type and environmental conditions.

The benefits of crack sealing include:

- **Water Infiltration Prevention:** It effectively prevents water from entering the pavement structure, reducing the potential for freeze-thaw damage and sub-base erosion.
- **Extended Pavement Life:** By maintaining the pavement's integrity, crack sealing extends its service life.
- **Cost Savings:** It is more cost-effective to seal existing cracks than to repair more extensive damage after water has entered and weakened the pavement.
- **Maintained Pavement Performance:** Crack sealing helps sustain the pavement's strength and performance by keeping the surface intact.

Crack sealing is considered a critical preventive maintenance activity and is typically performed on cracks that are actively widening and shrinking. It is more specialized than crack filling, as it uses materials designed to bond to the crack edges and stretch as the pavement moves, providing a longer-lasting solution.

# Hot Pour Mastic/Patch ($$)

Mastic seal is a type of thick, viscous asphalt material that is used to repair larger cracks, alligator cracking, cupping cracks, raveling, shoving, utility cuts, micro trenches, shallow depressions, rumble strips, potholes and depressions. Mastic can be used in both asphalt and concrete pavements. It is a blend of asphalt binder, fibers and aggregates that form a flexible and adhesive compound capable of filling and sealing irregularities in pavement surfaces.

The characteristics and benefits of mastic include:

- **Preparation:** Mastic can be used for ongoing pavement issues that come up at any time of the year. Mastic should also be installed at the same time as crack seal to prepare roads before any surface treatments planned for the summer.
- **Durability:** The material is designed to be highly durable and flexible, which allows it to accommodate the movements of the pavement and the changes in temperature without cracking.
- **Adhesion:** Mastic seal adheres well to the pavement surface, providing a strong bond that helps to prevent water infiltration and further deterioration of the pavement.
- **Load Bearing:** It can withstand heavy traffic loads, making it appropriate for use in both low- and high-volume traffic areas.
- **Ease of Application:** Mastic can be applied relatively quickly and does not require the removal of the existing pavement.
- **Smooth Transition:** When applied properly, it creates a smooth transition between the existing pavement and the repair area, which can improve ride quality.
- **Waterproofing:** By sealing cracks and joints, mastic helps to prevent water infiltration, which is a leading cause of pavement deterioration.
- **Longevity:** Repairs made with mastic tend to last longer than those made with more traditional patching materials, leading to longer intervals between maintenance.

Hot pour mastic/patch is typically applied using specialized equipment that heats the material to the required application temperature. It is then poured into the prepared area and leveled to match the surrounding pavement surface. It is a highly effective pavement preservation method for addressing intermediate to large-scale distresses that are beyond the capabilities of crack sealants but not yet severe enough to warrant complete pavement replacement.

# Spray Applied Preservation ($$-$$$)

A Spray Applied Surface Treatment provides a protective layer for asphalt surfaces, effectively preserving and extending their lifespan. This treatment acts as a barrier against water, UV rays, oils, oxidation and other harmful elements, making it an ideal treatment for a variety of applications, including roads, parking lots, walking trails and driveways. In addition to its protective qualities, it enhances the pavement's appearance, giving it a fresh, dark and uniform color.

## PAVEMENT DISTRESS TREATED BY SPRAY APPLIED SURFACE TREATMENT

Spray Applied Surface Treatment primarily addresses these types of pavement distress:

1. **Oxidation:** UV exposure can make asphalt brittle, leading to cracks and fading. This treatment blocks UV rays, reducing oxidation.
2. **Small Surface Cracks:** The treatment fills and seals small, hairline cracks, preventing water from penetrating and worsening them.
3. **Raveling:** When asphalt particles (like gravel) loosen and break off the surface, this treatment helps to keep those particles in place.

## APPLICATION PROCESS FOR SPRAY APPLIED SURFACE TREATMENT

1. **Surface Preparation:**
   - Clean the pavement thoroughly, removing all debris, dirt and oil spots.
   - Sweep or blow away loose gravel and dust, and power-wash the surface if necessary.
   - Repair any significant cracks or potholes in the asphalt before applying the treatment.
2. **Application:** The treatment is typically applied in two coats for even coverage and enhanced durability.
3. **Curing Time:** Allow the treatment to be fully cured before opening the area to traffic; consult the manufacturer for recommended curing times.
4. **Reopen for Use:** Once fully cured, the surface can be reopened to vehicle and pedestrian traffic.

## BENEFITS OF SPRAY APPLIED SURFACE TREATMENT

1. **Extended Pavement Life:** By acting as a protective barrier, Spray Applied Surface Treatment can significantly extend the lifespan of asphalt surfaces, reducing the need for costly repairs and replacements.
2. **Enhanced Aesthetic Appeal:** This treatment rejuvenates the appearance of pavement by restoring a fresh, dark, uniform color, creating a visually appealing and professional look for roads, parking lots and other asphalt surfaces.
3. **Increased Surface Durability:** The treatment mitigates damage from common elements, such as water, oils and UV rays, that can weaken and deteriorate the asphalt over time. It also seals small cracks, preventing them from expanding into larger, more costly issues.

4. **Improved Safety:** By addressing small surface cracks and reducing loose gravel or "raveling," this treatment helps maintain a smoother, safer surface for both vehicles and pedestrians.

Spray Applied Surface Treatments are produced in centralized facilities to ensure consistent quality. For optimal results, it's advisable to consult the manufacturer for guidance on curing times, coverage rates and surface preparation, as these may vary by product.

# Seal Coat ($$)

An asphalt seal coat is a protective layer applied to asphalt pavement to shield it from damage caused by weather, UV rays, chemicals and daily wear and tear. This treatment is typically made from a blend of asphalt emulsion, mineral fillers, water, and performance-enhancing additives. Acting as a durable barrier, it not only extends the lifespan of the pavement but also enhances its appearance. Seal coats are suitable for various surfaces, including roads, parking lots, walking trails and driveways.

### HOW AN ASPHALT SEAL COAT IS APPLIED

1. **Surface Preparation:**
   - The pavement is thoroughly cleaned to remove debris, dirt and oils.
   - Cracks and potholes are filled and repaired to ensure a smooth application surface.
2. **Application:**
   - The seal coat is applied using spray equipment, squeegees or brushes.
   - It is evenly applied in thin layers, often requiring one or two coats based on the pavement's condition.
3. **Curing:**
   - Seal coats typically require 24-48 hours to cure before the pavement is reopened to traffic.

### BENEFITS OF AN ASPHALT SEAL COAT

1. **Protection Against the Elements:**
   - Shields the pavement from UV rays, water and oxidation, which can degrade asphalt over time.
2. **Prevention of Cracks and Potholes:**
   - Exposure to sunlight and air causes asphalt to oxidize over time, making it brittle and prone to cracking. Seal coat blocks harmful UV rays and slows down oxidation, preserving the asphalt's flexibility and preventing it from becoming fragile.
3. **Enhanced Durability:**
   - Adds a protective layer that minimizes wear and tear from traffic and heavy vehicles.
4. **Improved Appearance:**
   - Restores the pavement's rich black color, giving it a newer and more attractive look.

# Fog Seal/Rejuvenator ($-$$)

A fog seal is a light application of a diluted, chemically-stabilized asphalt emulsion applied to the surface of aging asphalt pavements. Its primary purpose is to seal and enrich the surface, helping to extend the pavement's life by addressing issues such as minor cracking, pitting and raveling, and reducing the permeability of the asphalt surface. Fog seals are particularly useful for combating surface distress, protecting the pavement from further damage and enhancing the appearance by darkening the surface.

There are additional benefits of fog seals when applied after scrub seals and chip seals to help reduce the amount of "fly" rock by adding additional asphalt to help with chip embedment.

Here's an explanation of the benefits and characteristics of fog seals:

1. **Surface Enrichment:** Fog seals replenish the binder in the asphalt surface, which may have been lost due to oxidation and weathering.
2. **Sealing Minor Cracks:** While not a replacement for a proper crack-sealing program, fog seals can reduce the infiltration of water by sealing small, non-working cracks.
3. **Reducing Raveling:** Fog seals can help bind the aggregate particles together, thereby reducing raveling, which is the dislodgement of aggregate from the pavement.
4. **Reducing Permeability:** By filling surface voids, fog seals can reduce water infiltration, which is a primary cause of pavement deterioration.
5. **Enhancing Appearance:** A fog seal application darkens the asphalt surface, which can improve the visibility of pavement markings and the overall look of the pavement.
6. **Preventive Maintenance:** As part of a preventive maintenance program, fog seals are cost-effective treatments for extending pavement life.
7. **Surface Friction Consideration:** After application, fog seals can temporarily reduce surface friction. Caution should be used when applying fog seals to high-traffic areas.
8. **Non-Trafficked Surface Application:** Fog seals are recommended for non-trafficked surfaces such as shoulders and areas around general aviation airports to enhance aggregate retention and minimize potential sources of Foreign Object Debris (FOD).

It's important to note that fog seals do not improve fuel resistance, and they should not be applied to pavements that lack surface permeability. They are not designed to soften the underlying asphalt but to act as a sacrificial layer to protect the underlying surface.

# Sand Seal ($$)

A sand seal is a pavement preservation technique that involves the application of a quick-setting asphalt emulsion to the pavement surface, followed by a layer of fine aggregates, such as sand. This process provides a new wearing surface and can be used to fill small cracks and voids, improve skid resistance and protect the pavement structure by sealing the surface from the ingress of water and the effects of oxidation.

The process typically follows these steps:

1. **Surface Cleaning:** The existing pavement surface is cleaned to remove any dust, debris and loose material to ensure proper bonding of the asphalt emulsion.
2. **Asphalt Emulsion Application:** A quick-setting asphalt emulsion is sprayed onto the pavement surface using specialized equipment. The type of emulsion used is selected based on the existing pavement conditions and the desired performance characteristics.
3. **Sand Spreading:** Immediately after the emulsion is applied, clean sand is spread over the surface. The sand should be of a specified gradation that allows it to embed into the emulsion without completely obscuring it.
4. **Rolling:** Once the sand is applied, it is rolled with pneumatic tire rollers to ensure good contact and adhesion between the sand and the asphalt emulsion.
5. **Excess Sand Removal:** After the emulsion has cured, any excess sand is removed from the surface, typically with a mechanical broom or air blower.

The benefits of a sand seal include:

- **Improved Surface Texture:** The fine aggregate provides a textured surface that can improve skid resistance and traction for vehicles.
- **Pavement Preservation:** The seal serves as a barrier against moisture and sunlight, helping to slow down the oxidation of the asphalt binder.
- **Filling Minor Cracks:** The combination of asphalt emulsion and sand can penetrate and fill small cracks in the pavement surface.
- **Cost-Effectiveness:** Sand seals are relatively inexpensive compared to other surface treatments and can be a cost-effective method for maintaining low-volume roads.

Sand seals are typically used on low-traffic roads or as a part of a multi-layer surface treatment in combination with other seals. It is important to apply sand seals during warm, dry weather conditions to ensure proper curing of the asphalt emulsion.

# Scrub Seal ($$$$)

A scrub seal is a pavement preservation technique that involves the application of a modified asphalt emulsion to the road surface, followed by the application of an aggregate cover. The uniqueness of a scrub seal compared to other seals is the use of a scrub broom (a broom with flexible bristles) to work the emulsion into the cracks and crevices of the pavement surface before the aggregate is applied. This process enhances the seal's ability to fill cracks and ensures a better bond between the pavement and the seal.

Here's a step-by-step explanation of the scrub seal process:

1. **Surface Preparation:** The existing pavement is cleaned to remove debris, dust and other materials that may prevent good adhesion.
2. **Emulsion Application:** A modified asphalt emulsion is applied to the road surface using a distributor truck. The type of asphalt emulsion is selected based on existing pavement conditions and climate.
3. **Scrubbing:** Immediately after the emulsion is applied, a scrub broom that is attached to the distributor truck is used to work the emulsion into the pavement surface. The broom helps ensure that the emulsion penetrates into the cracks and voids, providing a better seal.
4. **Aggregate Application:** While the emulsion is still tacky, aggregate is spread over the surface. The aggregate type is chosen based on compatibility with the emulsion and desired surface characteristics.
5. **Rolling:** After the aggregate application, the surface is rolled with pneumatic tire rollers to embed the aggregate into the emulsion and to remove excess loose aggregate.
6. **Curing:** The scrub seal must be allowed to cure properly. This process involves the evaporation of water from the emulsion, leaving the residual asphalt to bind the aggregate to the pavement.
7. **Sweeping:** Once the curing is complete, any loose aggregate is swept from the surface.

The benefits of a scrub seal include:

- **Crack Sealing:** It effectively seals existing pavement cracks and prevents water infiltration, which can cause further pavement damage.
- **Improved Traction:** The new aggregate surface provides enhanced skid resistance and improved safety.
- **Cost-Effective:** As a pavement maintenance technique, scrub seals are less expensive than more extensive repairs or overlays.
- **Extended Pavement Life:** By providing a protective layer, scrub seals can extend the service life of the pavement.
- **Correcting Minor Surface Irregularities:** Scrub seals can help to fill small surface imperfections and improve ride quality.

Scrub seals are typically used on aging asphalt surfaces that require sealing and minor surface correction. They are effective for roads with low- to moderate-volume traffic, and the process is relatively quick, minimizing traffic disruption.

# Spot Repair ($-$$$)

Spot repairs include a variety of treatments to resolve localized pavement distress. They are effective when a relatively small portion of a roadway or parking lot requires a different treatment than the rest of the pavement.

They may include activities such as the following (this is not a comprehensive list):

- Removing and replacing damaged pavement.
- Patching to repair excavation for utility construction or repair.
- Filling and recompacting a utility trench or around a manhole and reconstructing the pavement section.
- Resolving drainage problems that lead to ponded water on the asphalt or along the edge of the asphalt.
- Excavating into the subgrade material, stabilizing it, and reconstructing the pavement section.
- Filling potholes.
- Widening asphalt to move the edge of asphalt farther away from the wheel path.
- Replacing poor quality patches.
- Placing additional asphalt to level the roadway surface.

The process of performing a spot repair is unique to the circumstances. Repairs typically don't take much time to perform and may be performed by just a few workers. However, they almost always require some form of traffic control and care should be taken to protect workers and the public.

The benefit of spot repairs is they provide an economical way to repair problem areas without having to perform a treatment over a large area when only a small portion of it needs to the treatment.

# Slurry Seal ($$$)

A slurry seal is a pavement preservation technique that combines asphalt emulsion, fine aggregate (typically sand) and water, sometimes including mineral fillers or additives. It is applied as a homogeneous mixture over existing pavement surfaces to extend their life. The mixture is produced in specially designed trucks or mixing units and then evenly spread across the surface using a spreader box and/or a squeegee attached to the back of a truck.

Here's a step-by-step explanation of the slurry seal process:

1. **Mix Preparation:** Slurry seal is mixed on-site in the slurry truck or paver. The mix is designed with the aggregate and emulsion being used and the performance requirements.
2. **Surface Cleaning:** Prior to application, the pavement surface is thoroughly cleaned to remove debris and dust to ensure proper adhesion of the slurry seal.
3. **Application:** The slurry seal is applied uniformly to the pavement surface using the spreader box. The thickness of the application is typically equal to the largest aggregate particle in the mix.
4. **Curing:** After application, the slurry seal needs time to cure. During curing, water in the slurry evaporates, leaving behind the asphalt binder, which then hardens.
5. **Opening to Traffic:** Once cured, the slurry seal provides a new, durable surface layer. The pavement can be reopened to traffic once the slurry seal is sufficiently set, which usually takes a few hours.

The benefits of slurry seal include:

- **Crack Sealing:** Slurry seal fills and seals cracks in the pavement, preventing water from penetrating and causing further deterioration.
- **Restored Surface Texture:** It provides a new, skid-resistant surface that enhances safety and ride quality.
- **Protection from Oxidation:** The new surface layer protects the underlying asphalt from oxidation caused by exposure to oxygen and UV rays.
- **Cost-Effective:** It is a cost-effective maintenance method that extends the life of the pavement without the need for more expensive repairs.
- **Aesthetic Improvement:** Slurry seal gives the pavement a uniform, black appearance, similar to new asphalt.
- **Quick Application:** The process is relatively quick, and the disruption to traffic is usually minimal compared to other resurfacing methods.

Slurry seal is suitable for low- to medium-volume roads, residential streets, parking lots and airports. It is not intended to correct structural issues but is used as a preventive maintenance technique to address surface aging and minor raveling and to seal the surface against the ingress of water.

# Chip Seal ($$$$)

A chip seal is a pavement surface treatment that combines one or more layers of asphalt with one or more layers of fine aggregate. It is a cost-effective way to provide a new driving surface that will protect the underlying pavement from moisture and provide a high level of skid resistance. Chip seals are used on a wide variety of pavements, from interstates to residential streets.

Here's the step-by-step process of chip seal application and its key characteristics:

1. **Cleaning:** The existing pavement surface is thoroughly swept or blown clean to remove debris and ensure proper adhesion of the asphalt binder.
2. **Binder Application:** A layer of asphalt binder (usually emulsified asphalt) is applied to the pavement surface. The type and grade of asphalt are chosen based on traffic levels, climate and the condition of the existing pavement.
3. **Aggregate Spreading:** Immediately following the binder application, clean, uniformly graded aggregate (chips) is evenly spread over the asphalt binder. The size of the aggregate is typically chosen based on the desired texture and the amount of traffic.
4. **Rolling:** Once the aggregate is applied, it is compacted into the binder with rubber-tired rollers to ensure good contact and embedment. This process also helps to remove excess loose chips.
5. **Curing Time:** After rolling, the chip seal needs time to cure. During this period, vehicles should either be kept off the surface or speed limits should be reduced to minimize the dislodging of chips.
6. **Excess Chip Removal:** After the binder has cured, any loose chips are swept away from the surface. This may be done a few days after the initial application to allow any loose chips to come free from the surface.

The benefits of chip seals include:

- **Sealing Cracks and Protecting Pavement:** Chip seals provide a barrier that seals small cracks in the existing pavement and protects it from the effects of oxidation and weathering.
- **Improved Skid Resistance:** The aggregate surface layer increases traction, providing a safer driving experience.
- **Cost-Efficient:** Chip sealing is a relatively low-cost alternative to traditional hot mix asphalt overlays.
- **Quick Application and Cure Time:** This treatment has a faster application and cure time compared to hot mix asphalt, which means roads can be opened to traffic sooner.
- **Aesthetic Improvement:** Chip seals can enhance the appearance of the pavement with a more textured, consistent look.

It's important to note that chip seals are most effective when applied to pavements in good condition with only minor distresses. They are not designed to add structural strength but rather to extend the life of the pavement by protecting the surface.

# Micro-Surfacing ($$$$)

Micro-surfacing is a more advanced form of slurry seal that uses a mixture of polymer-modified asphalt emulsion, graded aggregate, mineral filler, water and other additives. It is applied to existing road surfaces to create a new wearing surface and to address a variety of surface imperfections.

Here's a step-by-step process of micro-surfacing:

1. **Surface Preparation:** The existing pavement is cleaned to remove debris and loose particles to ensure the micro-surfacing material adheres properly.
2. **Mixing:** Micro-surfacing material is mixed on-site in specialized equipment known as a micro-surfacing mixing machine. The mix includes a polymer-modified asphalt emulsion, which provides enhanced performance characteristics compared to traditional slurry seals.
3. **Application:** The mixed micro-surfacing material is spread onto the pavement surface using a specialized spreader box attached to the machine. The spreader box ensures an even application at the specified thickness.
4. **Setting and Curing:** Micro-surfacing sets and cures quicker than traditional slurry seals due to the use of fast-setting polymers. This allows for a shorter period before the roadway can be reopened to traffic.
5. **Traffic Ready:** Typically, micro-surfacing can accommodate traffic within a couple of hours after application, which minimizes disruption and road closure time.

The benefits of micro-surfacing include:

- **Rutting and Raveling Reduction:** It can fill wheel ruts and prevent the loss of aggregate (raveling).
- **Skid Resistance:** The aggregate used in micro-surfacing provides a skid-resistant surface that improves safety.
- **Quick Traffic Return:** Due to its rapid setting time, micro-surfacing allows roads to return to service faster compared to other treatments.
- **Versatility:** It can be applied to various pavement types, including high-traffic roadways, residential streets and airport runways.
- **Cost-Effectiveness:** As a maintenance treatment, micro-surfacing is less expensive than more extensive repairs and can extend the life of the pavement.
- **Weather and Aging Protection:** It shields the pavement from the effects of weather and delays the aging process of the asphalt binder.

Micro-surfacing is suitable for addressing surface-level pavement issues such as oxidation, loss of friction and minor rutting. Microsurfacing is an exceptional product to fill ruts up to 1" thick due to failed asphalt with structurally sound base. It is not intended to repair structural damage or to correct significant base failures.

# Cape Seal ($$$$$)

A cape seal is a two-step pavement preservation process that combines two surface treatments: a chip seal or scrub seal followed by a slurry seal or micro-surfacing. This method provides the benefits of both treatments, resulting in a smoother surface than a chip seal alone and adding structural integrity to the pavement system, thus extending the life of the pavement.

Here's a step-by-step explanation of the cape seal process:

1. **Chip/Scrub Seal Application:** The first step is applying a chip/scrub seal, which involves spraying asphalt emulsion onto the existing pavement surface and then immediately covering it with a layer of uniformly sized aggregate chips. The chips are then compacted into the emulsion to form an interlocked adhesive layer.
2. **Curing of Chip Seal:** The chip seal layer must cure for typically one to two weeks. This allows the emulsion to set properly and the aggregate to become firmly embedded in the binder. During this period, any loose chips are swept off the surface.
3. **Slurry Seal or Micro-Surfacing Application:** Once the chip/scrub seal has properly cured, a slurry seal or micro-surfacing layer is applied over the top. This second step involves spreading a mixture of fine aggregates, asphalt emulsion, water and additives over the surface. This layer fills any remaining voids and provides a smooth, durable wearing surface.
4. **Curing of Final Surface:** The slurry seal or micro-surfacing layer is then allowed to cure. The curing time is typically shorter than for the chip seal, often just a few hours.

The benefits of a cape seal include:

- **Improved Surface Texture:** The final slurry or micro-surfacing layer provides a smoother surface than the chip/scrub seal alone, enhancing ride quality.
- **Enhanced Durability:** The combination of treatments results in a more durable surface that can better resist the effects of weathering and traffic.
- **Sealing Cracks:** The cape seal process seals cracks in the pavement, reducing water infiltration that can cause further damage.
- **Cost-Effectiveness:** Cape seals are more cost-effective than reconstructing or resurfacing with hot mix asphalt.
- **Extended Pavement Life:** By combining treatments, cape seals can significantly extend the life of pavement surfaces.

Cape seals are particularly effective on pavements with moderate to severe distress or where a chip/scrub seal alone would not provide a sufficiently smooth surface. They are suitable for both urban and rural roads, and the double-layer system is excellent for addressing issues like raveling, oxidation and loss of surface texture.

# Cold In-Place Recycling

Cold In-Place Recycling (CIR) is a method of reconstructing and rehabilitating existing pavement by recycling the existing asphalt pavement without applying heat. CIR can be applied to pavements that are structurally sound but have surface distresses. It is a cost-effective and sustainable approach to road maintenance, which conserves resources and reduces the environmental impact associated with traditional pavement reconstruction methods.

The CIR process typically involves the following steps:

1. **Milling:** The top layer of the existing pavement is milled to a predetermined depth, usually 2" to 5", using a cold planing machine.
2. **Crushing and Screening:** The milled asphalt material, known as Reclaimed Asphalt Pavement (RAP), is crushed and screened to achieve a consistent size and gradation.
3. **Mixing:** The RAP is mixed with a recycling agent, such as an emulsified or foamed asphalt binder, and possibly other additives, such as lime or cement. This mixture may also include virgin aggregate if needed to enhance the mix properties.
4. **Laying Down:** The recycled mixture is laid down on the prepared roadway base using a paving machine.
5. **Compacting:** The placed material is then compacted to achieve the desired density and to ensure proper bonding with the underlying layers.
6. **Curing:** The compacted layer is allowed to cure. During this period, the recycling agent reacts with the RAP, and the mixture gains strength.
7. **Surface Treatment:** A new surface course, such as an overlay of hot mix asphalt (HMA), is often applied over the recycled layer to provide a smooth driving surface and to protect the recycled pavement.

The benefits of CIR include:

- **Cost Savings:** CIR reduces the need for new materials, thereby lowering construction costs.
- **Environmentally Friendly:** The process reduces the carbon footprint by recycling existing materials and using less energy compared to traditional asphalt production.
- **Reduced Construction Time:** CIR can be completed more quickly than full pavement reconstruction, minimizing traffic disruption.
- **Enhanced Pavement Properties:** The process can improve the overall quality and performance of the pavement by correcting distresses and restoring structural integrity.
- **Conservation of Resources:** CIR uses existing pavement materials, conserving natural resources and reducing the need for quarrying and hauling new materials.

CIR is most effective when applied to pavements with surface distress, such as cracking and raveling, but with a strong underlying base. It is not suitable for pavements with significant structural failures or poor subgrade conditions.

# Hot In-Place Recycling

Hot In-Place Recycling (HIR) is a pavement rehabilitation method that involves the treatment and reuse of the existing asphalt pavement material, conducted on-site and in-place. HIR renews the pavement by heating, softening and rejuvenating the asphalt surface layer, which can then be remixed, reshaped and compacted to create a restored pavement structure.

The HIR process includes the following steps:

1. **Heating:** Specialized equipment heats the existing asphalt pavement to a temperature high enough (usually around 300°F) to make it pliable and workable without causing damage to the asphalt binder.
2. **Milling or Scarifying:** The top layer of the heated pavement is mechanically removed (milled) or scarified to a specified depth, typically 1" to 4".
3. **Rejuvenating:** A rejuvenating agent is added to the milled material to restore some of the properties lost due to oxidation and aging of the asphalt binder.
4. **Mixing:** The reclaimed asphalt is mixed to ensure a uniform coating of the rejuvenating agent and to achieve the desired consistency and gradation.
5. **Laying:** The recycled mixture is then laid back down onto the pavement using a paver.
6. **Compacting:** The mixture is compacted using rollers to produce a dense, smooth pavement layer.
7. **Applying an Overlay (if required):** In some HIR processes, after the recycled layer has been placed and compacted, an additional new hot mix asphalt overlay may be applied to provide additional structural capacity and a smooth driving surface.

The benefits of HIR include:

- **Environmental Stewardship:** HIR reduces the need for new materials and the associated environmental impacts of extraction, production and transportation.
- **Cost-Effectiveness:** By reusing existing pavement materials, HIR can be more cost-effective than conventional remove-and-replace methods.
- **Speed of Construction:** HIR can be performed quickly, minimizing traffic disruptions and road closures.
- **Energy Efficiency:** The HIR process uses less energy compared to producing new hot mix asphalt.
- **Enhanced Pavement Performance:** The process can improve pavement performance by correcting ruts, cracks and other surface distresses, restoring flexibility and improving skid resistance.

HIR is suitable for pavements where the distress is confined to the upper portion of the pavement structure. The process is not recommended for pavements with severe structural deficiencies, poor subgrade conditions or where full-depth reconstruction is needed.

# Hot Mix Asphalt Overlay

A hot mix asphalt (HMA) overlay is a road maintenance technique that involves the placement of a new layer of hot mix asphalt over an existing paved surface, such as a deteriorating roadway or airport runway. This new layer, which can vary in thickness, is intended to extend the life of the pavement by providing a new, smooth and durable surface.

Hot mix asphalt is a mixture of aggregate (stone, sand or gravel) bound together by asphalt cement, a product of crude oil. HMA overlays are applied hot and compacted to form a solid, dense surface. The process of creating an HMA overlay typically includes the following steps:

1. **Preparation of the Existing Pavement Surface:** The existing surface is cleaned, and any necessary repairs are made. This might include patching potholes, fixing cracks and ensuring a proper profile through milling if required.
2. **Application of Tack Coat:** A tack coat, a light application of asphalt emulsion, is applied to the existing surface to promote bonding between the old and new pavements.
3. **Laying the HMA Overlay:** The hot mix asphalt is transported to the site in trucks, laid down by a paver and then compacted using rollers. The compaction process is essential to ensure that the overlay is fully compacted, has minimal air voids and achieves maximum density.
4. **Cooling:** After compaction, the new HMA overlay is allowed to cool to an ambient temperature before being opened to traffic.

The thickness of an HMA overlay will depend on the existing pavement condition and the expected future traffic loads. Thin HMA overlays (typically 1.5” or less) are often used as a preventative maintenance measure or to improve ride quality, while thicker overlays may be used to add structural capacity to a pavement.

HMA overlays are a popular choice for pavement rehabilitation due to their ability to be quickly constructed with minimal traffic disruption and their compatibility with a wide range of temperatures and loading conditions.

# Ultra Thin HMA

Ultra Thin HMA is a preventive maintenance treatment used to extend a pavement’s service life, protect the pavement structure and restore pavement smoothness. It is a specialized hot mix asphalt mixture with very specific mix design requirements that allow for placement at approximately ¾” thickness.

# Bonded Wearing Course

A Bonded Wearing Course (BWC) is a high-performance, thin overlay that combines a polymer-modified asphalt emulsion with high-quality, gap-graded aggregate. This pavement preservation method is applied to existing pavement surfaces to provide a new, durable, skid-resistant wearing surface. It's designed to seal the existing pavement from water and air intrusion, improve the ride quality and extend the service life of the road.

The BWC process typically involves the following steps:

1. **Surface Preparation:** The existing pavement is cleaned to remove any dirt, debris or loose particles to ensure a strong bond with the overlay.
2. **Tack Coat Application:** A tack coat of polymer-modified asphalt emulsion is applied to the pavement surface to enhance the bond between the old and new layers.
3. **Aggregate Application:** Immediately after the tack coat application, a layer of gap-graded aggregate is placed on top of the emulsion. The aggregate is chosen for its cleanliness, angularity and durability.
4. **Compaction:** The aggregate is then compacted into the emulsion using pneumatic or vibratory rollers to ensure proper embedment and to achieve a dense, interlocked wearing surface.
5. **Curing:** The newly applied BWC must cure properly before being opened to traffic. The curing time depends on factors such as temperature, humidity and the type of emulsion used.

The benefits of a Bonded Wearing Course include:

- **Improved Skid Resistance:** The gap-graded aggregate provides excellent skid resistance, enhancing roadway safety.
- **Rutting and Reflective Cracking Resistance:** The polymer-modified emulsion and gap-graded aggregate create a flexible layer that can resist rutting and slow the propagation of reflective cracking.
- **Waterproofing:** BWC seals the existing pavement surface, protecting the underlying layers from water infiltration and associated damage.
- **Noise Reduction:** The open texture of the aggregate can lead to reduced tire-pavement noise.
- **Quick Traffic Return:** BWC application allows for a relatively quick return to service, minimizing disruption to traffic.
- **Long Service Life:** When properly applied, a Bonded Wearing Course can significantly extend the life of the pavement.

BWC is appropriate for both asphalt and concrete pavements and is often used on high-volume roads and highways due to its durability and performance benefits. It is a cost-effective solution for treating surface distress and improving ride quality without the need for a thicker traditional hot mix asphalt overlay.

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# NOTES

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# UAPA MISSION STATEMENT

The Utah Asphalt Pavement Association (UAPA) is committed to being the unified voice of the asphalt industry to promote the quality and use of asphalt pavements in Utah.

For more information, please visit **utahasphalt.org**.