

The ABCs of

PAVEMENT PRESERVATION



Ontario Hot Mix
Producers Association



The ABCs of Pavement Preservation

The Right Treatment to the Right Pavement at the Right Time

There is nothing new about pavement preservation and preventive maintenance. People have been filling potholes and repairing cracks since the first asphalt pavement was laid back in the late 1800s. But have we been doing a good job? Probably not and that's because our maintenance programs have been reactive rather than proactive.

Smile: When the dentist fills a tooth, that's a corrective maintenance technique. When the dental hygienist cleans your teeth, that's a preventive maintenance technique. Regular visits to the dentist combined with a "conscientious program of oral hygiene" - that is a preventive maintenance program.

Preventive maintenance is a strategy - an organized, systematic approach that maintains or improves the condition of a road and slows future deterioration. It saves money, improves safety and rideability and puts a smile on the face of users and owners alike.

Pavement Preservation changes your approach:

- ▲ Look for and correct small problems before they become big ones
- ▲ Eliminate the "worst first" syndrome

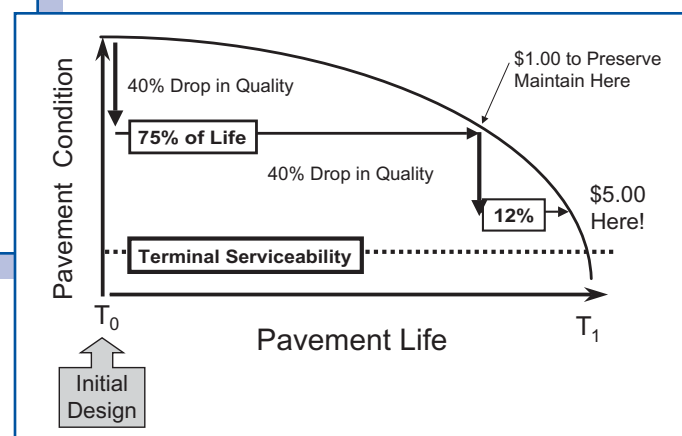
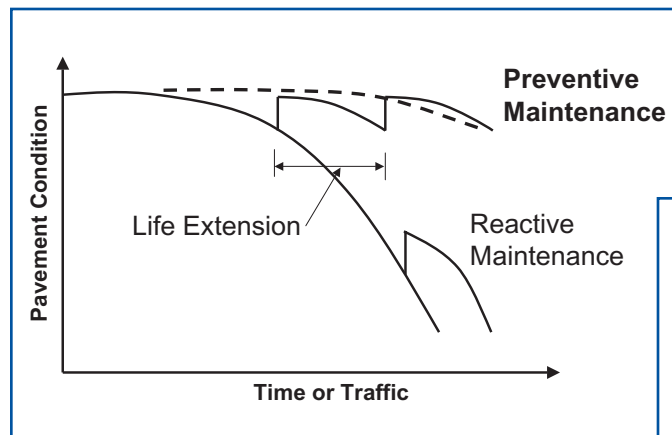
Pavement Preservation is efficient, effective and economical.

- ▲ save money
- ▲ improve safety
- ▲ reduce delays
- ▲ help pavement last longer
- ▲ improve the performance of the entire road network

The ABC's of Pavement Preservation

- A. The Right Pavement
- B. The Right Time
- C. The Right Treatment

If you are filling potholes and repairing major cracks, it's probably too late.



Doing it Right

A. The Right Pavement: Trying to keep track of several hundred kilometres of pavement is no easy task but if your maintenance program relies on public complaints to identify defects, you are probably too late.

For the most efficient use of maintenance resources, you need to look for early indicators of pavement distress - in other words, find the right pavement for treatment.

An up-to-date pavement condition survey is the first step. The survey will establish a comprehensive database that identifies the type of pavement distresses in the road network and evaluates those distresses based on severity and extent.

It's not as onerous a job as it sounds. The tools are already available. Almost all municipalities in Ontario have a Pavement Management System in one form or another that can easily incorporate the information needed for a preventive maintenance program in an organized and easily accessible fashion.

B. The Right Time: The right time for preventive maintenance treatments is during the early stages of a pavement's life. You need to apply preventive maintenance treatments before the problem gets out of hand, not after. It makes sense, for example, to rout and seal before a single crack spreads into multiple cracks. In fact, spending a dollar on preventive maintenance in the tenth year of a pavement's life can save up to five dollars in corrective maintenance five years later.

Knowing when a pavement needs to be treated is one thing. Carrying out the treatment on time and on schedule is another matter. When money is tight, preventive maintenance is usually well down on the priority list and often one of the first items sacrificed in budget cutbacks. Knowing the right time to apply a preventive maintenance technique is important. Having the funds to apply that technique at the right time is essential. Dedicated funding needs to be part of any preventive maintenance program.

C. The Right Treatment: There are a number of preventive maintenance techniques, each of which has been specifically developed to treat a particular type of distress at a particular level of severity.

Picking the right treatment will depend on:

- ▲ The type of pavement
- ▲ The type, extent and severity of the pavement distress
- ▲ The age of the pavement (or the time since the last major rehabilitation)
- ▲ The type of the road - its use, volume, and traffic speed
- ▲ The availability of qualified contractors, construction technology; materials and qualified agency staff
- ▲ The time of year for maintenance
- ▲ How long maintenance will take and the impact it will have on drivers
- ▲ The pavement quality needed after the pavement has been treated.

Remember that selecting the right treatment is as much an economic decision as a technical one. While the cost of preventive maintenance generally pales against the cost of corrective action needed if distresses are allowed to proceed unchecked, the cost and benefits of preventive maintenance treatments should still be analyzed. Estimates of benefits should be based on the extension of the life of the pavement, not on the expected life of the treatment itself.

- ▲ A cost-benefit analysis compares the cost of the preventive maintenance technique to the expected benefit (usually the extension of life of the pavement)
- ▲ Ranking adds less quantifiable benefits (user costs, safety, rideability) to the cost-benefit analysis
- ▲ Life cycle costing adds a degree of sophistication to a cost-benefit analysis by introducing the concept of the time-value of money.

Signs of Distress

Ravelling: the separation of the surface aggregate from the asphalt binder usually due to oxidation. Surface treatments are indicated.

Bleeding or flushing: excess asphalt cement on the surface of the road. Caused by excessive amounts of liquid asphalt binder or densification due to heavy traffic. Usually seen in hot weather. A seal coat can help.

Rutting: longitudinal deformation of the pavement caused by heavy traffic. May be corrected by milling, overlays and microsurfacing.

Corrugation or "washboarding": transverse deformation of pavement caused by poor compaction technique or shifting of the subgrade. Cannot be fixed by preventive maintenance methods.

Fatigue or alligator cracking: interconnected cracking with a pattern resembling the hide of an alligator. Caused by base failure. Mild cases of alligatoring with minimal base involvement can be treated with slurry seals.

Potholing: bowl-shaped holes of various size in the pavement. Potholes generally start as small localized spots of alligator cracking or surface disintegration combined with a weak base. As moisture infiltrates the area, small pieces of asphalt and base are dislodged and pop out under traffic. Good preventive maintenance techniques can eliminate problems before the pothole forms. Otherwise, clean and fill.

Polishing: a smooth slippery surface produced as the aggregate is worn by traffic. Grind, surface treat or overlay depending on severity.

Reflective cracking: cracks in the surface of the pavement due to underlying cracks in the pavement. Cannot be fixed by surface treatment.

Edge cracking: longitudinal or crescent shaped cracks within the first 30 cms of the pavement edge. Treat with sealants or seals.

Pavement Treatment Selection Guide

Pavement Condition	Parameters	Treatment								
		Thin Hot Mix Overlay	Fog Seal	Crack Sealing	Sand Seal	Chip Seals	Slurry Seal	Micro-surfacing	Cold In-Place Recycling ²	Hot In-Place Recycling ²
Traffic (ADT) ^{1, 2}	<1000	●	●	●	●	●	●	●	●	●
	1000 — 4000	●	●	●	●	●	●	●	●	●
	>4000	●	◐	●	○	◐	◐	◐	◐	◐
Ruts	<5mm	●	●	●	●	●	●	●	◐	●
	5mm — 25mm	◐	○	◐	◐	◐	◐	●	◐	●
	>25mm	○	○	○	○	○	○	◐	◐	◐
Cracking Fatigue	Low	●	◐	●	●	●	○	●	●	○
	Moderate	●	○	◐	◐	●	○	◐	●	●
	High	◐	○	○	○	○	○	○	●	●
Cracking Longitudinal	Low	●	◐	●	●	●	●	●	●	◐
	Moderate	●	○	●	◐	●	◐	◐	●	●
	High	◐	○	◐	○	○	○	○	●	◐
Cracking Transverse	Low	●	◐	●	●	●	●	●	●	●
	Moderate	●	○	●	◐	●	◐	◐	●	◐
	High	◐	○	◐	○	○	○	○	●	○
Surface Condition	Dry	●	●	○	●	●	◐	●	◐	●
	Flushing	●	○	○	◐	●	○	●	◐	●
	Bleeding	●	○	○	○	◐	●	●	◐	●
	Variable	●	◐	○	◐	●	●	●	◐	◐
	Portland Cement Concrete pavement	●	○	◐	●	●	●	●	○	○
Ravelling	Low	●	●	○	●	●	●	●	◐	●
	Moderate	●	◐	○	●	●	●	●	◐	●
	High	●	◐	○	●	●	◐	●	◐	●
Potholes	Low	●	○	●	●	●	●	●	○	○
	Moderate	●	○	◐	◐	◐	◐	◐	○	○
	High	●	○	◐	○	○	◐	◐	○	○
Texture	Rough	●	○	○	◐	◐	●	●	◐	●
Ride	Poor	●	○	○	○	○	●	◐	◐	●
Drainage	Poor	○	○	○	○	○	○	○	○	○
Snow Plow Damage	High	●	●	●	●	◐	●	●	○	○
Skid Resistance	Low	●	○	○	●	●	●	●	○	◐

- = Recommended
- ◐ = Provisionally recommended (dependant on road conditions)
- = Not recommended

This table provides general guidelines only. Each road should be assessed for the causes of distress and condition before a specific treatment is selected. Chart recommendations assume good quality design and construction. (Developed by Ontario's Asphalt Emulsion Manufacturers)

¹ Truck traffic as a percentage of ADT should be considered
² When treatment used in conjunction with HMA overlay

Hot Mix Overlay

Placing a layer of hot mix over existing pavement. Thin overlays are at least 40mm thick if conventional asphalt is used but thinner overlays can be laid with specialized mixes. The most common rehabilitation technique (as opposed to preventive maintenance technique) is a similar form of hot mix overlay. Commonly known as "Shave and Pave", the process involves the contractor milling and replacing up to 80mm of asphalt. Thicker overlays can extend the life of a pavement by between 15 and 20 years.

Benefits:

- ▲ provides new waterproof surface
- ▲ mitigates surface ravelling
- ▲ seals small cracks
- ▲ improves ride quality and corrects surface irregularities
- ▲ improves surface friction

Selection and Application: used on stable pavements with a sound base, but have a surface which exhibits minor surface distresses such as cracking, rutting, ravelling and roughness. Can be used to strengthen pavements. Do not use on pavements showing structural distress or pavement failure. Defects will quickly reflect through the new surface.

Service Life: 8 – 14 years

Fog Seal

A light application of diluted slow-setting emulsion.

Benefits:

- ▲ rejuvenates dry and brittle asphalt surfaces
- ▲ seals very small cracks and surface voids
- ▲ slows the rate of weathering and oxidation

Selection and Application: Use on structurally sound pavements to improve surface conditions on pavements showing signs of minor cracking, weathering, segregation or ravelling.

Service Life: 1 – 2 years

Crack Sealing

Routing, cleaning and filling the crack with sealant. Moisture infiltration is the primary cause of pavement deterioration. Crack sealing prevents water and debris from entering a crack. 'Crack Filling' does not involve routing and does not fully seal the crack.

Benefits:

- ▲ prevents moisture and debris from getting into cracks
- ▲ prevents water damage to the pavements structure
- ▲ extends pavement life by 3 – 5 years

Selection and Application: use for cracks less than 25mm wide, spaced uniformly along the pavement and with limited edge deterioration. Use Crack Filling for older pavements with wider, more random cracking. Best applied during cool dry weather (0°C - 15°C) when cracks are almost fully open.

Service Life: 3 – 5 years

Chip Seals

A uniform application of asphalt emulsion to a prepared pavement surface followed by a rolled aggregate cover (OPSS 304 Class 1-6 Surface Treatments). Can postpone the need for heavier surface treatments or resurfacing for 2 to 4 years.

Benefits:

- ▲ improves surface friction
- ▲ slows surface ravelling and oxidation
- ▲ corrects minor deformations and seals small cracks
- ▲ provide temporary cover for a base course until the final asphalt courses can be placed

Selection and Application: Provides an economical all-weather surface for light to medium traffic (polymer-modified emulsions and high quality aggregates should be used for higher traffic volume applications). Must be applied to structurally sound pavements.

Service Life: 5 – 7 years for chip seals; 2 – 4 years for sand seals

Slurry Seal

A cold mix paving technique using a mixture of dense-graded aggregate, asphalt emulsion, water, and mineral fillers.

Benefits:

- ▲ improves surface friction
- ▲ slows surface ravelling and seals small cracks
- ▲ improves ride quality and corrects surface irregularities

Selection and Application: use on stable pavements with a sound base showing minor surface distresses such as cracking, rutting, ravelling and roughness. Do not use on pavements with structural distress, as cracks will quickly reflect through new surface. Minimum thickness is 9.5mm.

Service Life: 4 – 7 years

Michigan's goal is
a model of clarity:

Keep good roads good.

Micro-surfacing

The application of a cold mix of dense-graded aggregate, polymer modified asphalt emulsion, water, and mineral fillers. Capable of filling wheel ruts up to 40mm deep when the pavement has stabilized and is not subject to plastic deformation.

Benefits:

- ▲ improves surface friction
- ▲ slows surface ravelling and seals small cracks
- ▲ improves ride quality and corrects surface irregularities

Selection and Application: Used on stable pavements with a sound base that have minor surface distresses such as cracking, rutting, ravelling and roughness. Can be used to correct rutting. Do not use on pavements showing structural distress or pavement failure. Defects will quickly reflect through new surface.

Service Life: 5 – 7 years

Cold In-Place

Reprocesses existing pavements in-situ to a depth of 100 mm. Typically overlaid with one or two lifts of HMA to produce a sound pavement structure. All cold in-place work should be completed with an appropriate wearing surface.

Benefits:

- ▲ uses 100% existing aggregates and asphalt
- ▲ mitigates reflective cracking
- ▲ corrects cross fall and longitudinal grades of existing pavements

Selection and Application: use on stable pavements with a sound base showing surface distresses such as cracking, rutting, ravelling and roughness. For light to medium traffic, a surface treatment such as chip seal is sufficient. For heavier traffic, at least one overlay is recommended.

Service Life: 10 – 12 years

People are prepared to
spend money to
maintain their cars.

Why wouldn't they be
equally prepared to spend
money to maintain their roads?

Hot in Place Recycling

Heating the existing pavement and reblending the asphalt. Rejuvenators and virgin hot mix may be added. Typical thickness: 25 - 50 mm.

Benefits:

- ▲ provides new waterproof surface
- ▲ slows surface ravelling
- ▲ seals small cracks
- ▲ improves ride quality and corrects surface irregularities
- ▲ improves surface friction

Selection and Application: used on stable pavements with a sound base, but have a surface which exhibits minor surface distresses such as cracking, rutting, ravelling and roughness. Can be used to strengthen the pavement when applied in conjunction with an HMA overlay. Do not use on pavements showing structural distress or pavement failure. Defects will quickly reflect through the new surface.

Service Life: 5 – 12 years

Cold Planing or Milling

Removes bumps, ruts and irregularities, restores the profile and leaves a uniform, textured surface.

Benefits:

- ▲ improves ride quality and corrects surface irregularities
- ▲ improves surface friction

Selection and Application: Cold plane before applying a recommended resurfacing product. A tack coat should be applied to all milled surfaces prior to paving the new riding course

Service Life: Typically resurfaced within 48 hours. When overlaid with HMA, service life is similar to mill and overlay treatment.

Cape Seal

A chip seal followed by a slurry seal. Stronger than a chip seal alone.

Benefits:

- ▲ improves surface friction
- ▲ slows surface ravelling, seals small cracks
- ▲ improves ride quality and corrects surface irregularities

Selection and Application: use on stable pavements with a sound base showing minor surface distresses such as cracking, rutting, ravelling and roughness. Do not use on pavements with structural distress, as cracks will quickly reflect through new surface.

Service Life: 5 – 7 years

Developing a Preventive Maintenance Program

When Canadian municipalities were asked in a recent survey "how do you select projects for preventive maintenance and rehabilitation", one-third said they use the "worst-first" criteria.

That is a stunning admission. Preventive maintenance doesn't just happen. Like all good programs it needs organization and it needs structure.

1. Establish the management aspects of the program:

Preventive maintenance is a way of technical thinking, financial planning and budgeting.

Use a simple goal to maintain focus and a sense of purpose.

2. Establish the technical aspects of the program:

A good preventive maintenance program should fold neatly into a Pavement Management System. Develop guidelines for evaluating pavement conditions, predicting pavement performance and setting priorities. All maintenance and rehabilitation actions must be co-ordinated and in sync.

3. Determine maintenance needs:

A condition survey shouldn't just tell you which pavements have problems that need correcting today. It should also tell you which pavements need treatment today to avoid problems tomorrow.

4. Provide a framework for treatment selection:

There is no shortage of preventive maintenance techniques. Picking the right one at the right time and at the right cost is what engineering is all about. Whether it is based on life cycle costing, decision trees or any number of other analytical tools, make sure that you use a consistent, logical framework to decide what to do.

5. Set priorities:

If you didn't have a budget, you wouldn't need to set priorities. Life's not like that. Set priorities so that the most important tasks don't get lost in the shuffle.

6. Monitor, Measure and Assess:

Is it working? There is only one way to find out. Monitoring and measuring the program allows you to make sure that you are picking the right treatments for your particular situation and conditions and that those treatments are, indeed, meeting the objectives. If they are, you have all the evidence you need to keep the program (and the funding) going. If they are not, then make the adjustments needed.

Measurable goals:

- ▲ pavement condition
- ▲ average rating
- ▲ percent of pavements in condition category
- ▲ cost savings

Proving the case

Michigan's Department of Transportation established its preventive maintenance program in 1992 with the express goal of "keeping good roads good."

In the first five years of the program, the Michigan DOT spent US\$80 million on preventive maintenance. Was it worth it? The Michigan taxpayers think so. Without the preventive maintenance program, according to one study, the state would have had to spend \$700 million on rehabilitation to bring the roads up to the same condition.

Georgia spends between US\$70 million and \$80 million a year on preventive maintenance. The state is committed to rehabilitating 10% of the network every year and resurfacing the entire network every 10 years. A study showed that between 1992 and 1997, the smoothness of asphalt pavements in Georgia improved by 300%.

Municipalities across Ontario such as Toronto and Ottawa that have implemented preventive maintenance strategies are anticipating similar benefits and are now documenting their programs to help sell their strategies to the taxpayer.

Selling the Case

Just as it takes consistent preventive maintenance to keep roads in good condition, it takes consistent funding to keep a preventive maintenance program in good shape. And therein lies the challenge.

Municipal engineers and road superintendents know how important a pavement preservation program is. They know that treating small problems before they become big problems is a smart and responsible way to spend taxpayers' money. But even though the benefits are impressive (less expensive treatments, longer pavement life, less user delays), they won't sell themselves.

Selling it to the Public: When it comes to roads, people tend to think locally not globally. It is the pothole at the end of the driveway, the rough pavement near the school and the ruts in the nearby intersection that they are concerned about and that puts municipal engineers on the spot.

Preventive maintenance is all about fixing small problems before they become big problems and small problems are not always easy for the untrained eye to spot. People are understandably sceptical when they see a crew working on a road that appears to be in good condition while ignoring a rough patch of road right outside their driveway. Faced with vociferous complaints, it's all too easy to fall back on the "worst-first" syndrome.

Fortunately, the public is more than capable of being sensible and sympathetic when presented with the facts. People know how important a well-maintained road network is for their community and they also know the importance of spending tax dollars wisely.

Measuring and assessing the program provides the facts. Good communication makes sure that the public understands them.

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Selling it to the Administration: When budgets get tight (and that's most of the time), it's easy to sacrifice long-term returns for short-term needs. Easy but not necessarily wise. If a program such as preventive maintenance that depends on continuity is delayed or curtailed, it can nullify years of hard won success.

Preventive maintenance can only work if the program is applied consistently and the program can only be applied consistently if there is a sustained, predictable level of funding.

Can politicians be persuaded? Given the evidence that a relatively small expenditure in preventive maintenance can save enormous sums of money in a relatively short time, there is no reason why they shouldn't be. Politicians make long term decisions all the time and most are fully prepared to make the right choices. After all, there is always life after the next election.

Pavement Rehabilitation

Preventive maintenance is an essential tool for extending the life of a pavement. Used early in a pavement's life, preventive maintenance corrects small problems before they become big problems, saves money, reduces delays and improves safety and rideability.

Preventive maintenance is, however, only one of the tools that municipal engineers have at their disposal for maintaining and preserving the road network. Preventive maintenance corrects small problems. It cannot be used to fix major problems that all roads experience as they wear. For that you need pavement rehabilitation.

All roads (other than those designed specifically as "perpetual pavements") will require rehabilitation as they get close to the end of their useful life and, as with preventive maintenance, there are a number of techniques and strategies that engineers and contractors can use to ensure that an asphalt pavement provides the best possible value for the taxpayers and users of the road network.

For the latest information on pavement rehabilitation, call the Ontario Hot Mix Producers for the ABCs of Pavement Rehabilitation.



The Ontario Hot Mix Producers Association

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The Fine Print: This brochure is designed as a general guide to pavement preservation. It is not a design manual. Professional engineers should be consulted to ensure that pavements are not only designed functionally but also economically to fit your budget requirements.