UNH T² Center Technical Note

Pavement Preservation: Right Treatment, Right Road, Right Time

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Most people believe that a road in poor condition should be fixed first. However, pavement preservation stresses applying the *right treatment*, on the *right road*, at the *right time*. This means that road managers should be maintaining their existing "good" infrastructure first instead of fixing the "worst" roads first.

The "right" treatment refers to the best treatment or maintenance option for a particular road. The "right road" refers to the road that is still in "good" condition. The "right time" is before the pavement is severly damaged. The public is largely unaware of the "right treatment, right road, right time" concept. This is part of the challenge for road managers.

Road managers should complete smaller, less expensive repairs frequently to prolong major rehabilitation that all roads need eventually. A good pavement maintenance program will help avoid prolonged traffic disruption for major road projects and will save the community time and money.

According to the FHWA, "with timely preservation [municipalities] can provide the traveling public with improved safety and mobility, reduced congestion, and smoother, longer lasting pavements."

The goal of a pavement preservation program is to enhance pavement performance and extend road "life". This goal is accomplished through three main components: preventative maintenance, routine maintenance, and pavement rehabilitation.

Preventative Maintenance

Preventative maintenance is defined as "a planned strategy of cost-effective treatments to an existing roadway systems and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without significantly increasing the structural capacity)" according to the AASHTO Standing Committee on Highways.

Road managers should apply preventative maintenance to roads that are still in good condition as these roads are expected to have a long "service life" remaining. Preventative maintenance treatments include "asphalt crack sealing, chip sealing, slurry or micro-surfacing, thin and ultra-thin hot-mix asphalt overlay, concrete joint sealing, diamond grinding, dowel-bar retrofitting, and isolated, partial, and/or full-depth concrete repairs to restore functionality of the slab; e.g., edge spalls, or corner breaks" (*FHWA*).

The first tenet of pavement preservation states "right treatment." Not all road treatments and maintenance activities are considered to be pavement preservation, or part of a pavement preservation

program. Pavement preservation activities are characterized by their intended purposes. Any treatment that is designed to restore the function of the existing road system and extend its service life is considered to be part of a pavement preservation program. Treatments that increase capacity or strength, while important, are not intended to preserve the lifetime of paved roads, and as such are not part of pavement preservation. The treatments that will be discussed and explained in this article are fog seals, crack sealing and crack filling, chip seals, slurry seals, micro surfacing, and thin asphalt overlays.

Fog Seals

Fog seals are a method of pavement preservation that adds asphalt to an existing pavement surface. Fog seals are an inexpensive treatment that involves "spreading a diluted asphalt emulsion on the roadway" (*Brown 24*). This emulsion contains no added aggregate and is diluted to about 50%.

The intended purpose of a fog seal is to seal the pavement—by spreading the emulsion over the asphalt, raveling on the paved road is prevented and the asphalt is enriched. Fog seals can also be used to waterproof the road surface, prevent stone loss, and improve the surface appearance.

To achieve its goal of pavement preservation, the fog seal emulsion essentially fills the voids in the surface of the paved road, creating a smooth and waterproof surface that protects the road from further damage. If a fog seal is inappropriately applied, however, the result can be a very slick pavement. This can generally be avoided by ensuring that the emulsion is properly diluted before application—the FHWA provides checklists for all of the treatments explained in this article. Fog seals are a suitable treatment for roads that have an open surface texture and are weathered, heavily aged, and/or open graded.

Crack Sealing & Crack Filling

Crack sealing and crack filling prevent the intrusion of water and other materials into the pavement cracks, which prevents further deterioration from the spreading of the cracks. Filling cracks is considered short-term treatment between major maintenance or rehabilitation projects.

Crack sealing and filling are the right treatment for paved roads when the roadway base is sound, and the cracks are between 3 mm and 25 mm (0.1 inch to 1 inch). Crack sealing and filling can be completed during any time of year but work best when the temperature is cooler.

Decide whether a crack is "working" or "non-working" first in order to know whether to crack seal or crack fill. A "working crack" is a crack that has a large amount of horizontal movement. A "non-working" crack has a small amount of horizontal movement. Road managers should crack seal working cracks and crack fill non-working cracks.

When crack sealing, a crack sealant should be chosen that is capable of "remaining adhered to the walls of the crack, elongating to the maximum opening of the crack and recovering to the original dimensions without rupture, expanding and contracting over a range of service temperatures without rupture or delamination from the crack walls, and resisting abrasion and damage caused by traffic" (*Caltrans 3-6*).

There is less preparation work for crack filling and road managers can use material that have lower performance requirements that those used for cracksealing. For example, the materials used for crack filling do need some elasticity to accommodate the movement of the cracks but they do not need to be nearly as elastic or flexible as materials used for crack sealing.

Chip Seals

The process of a chip seal is simple: an asphalt binder is sprayed on to the pavement, and then is covered by one layer of aggregate of a uniform size (the "chips"). After the chip seal is applied, the road is rolled to ensure a proper seal, and the debris is swept away.

Chip seals must be used on structurally sound roads in fair to good condition since they do not

increase the structural capacity of the road. Road managers should use chip seals on roads that display a loss of surface texture. Chips seals provide a method of cost-effective treatment that protects the pavement underneath it and extends the service life of the paved road. A chip sealed road is waterproof. Small cracks and imperfections that were present on the old surface are sealed.

Chip seals are one of the most cost effective methods of treatment—the initial treatment itself is inexpensive and can last five to seven years. With multiple applications, it is possible for the chip seal to last ten years.

Slurry Seals

Like a chip seal, a slurry seal protects the pavement underneath and improves the surface of the paved road. If used on a newly paved road, a slurry seal will actually prevent surface problems, such as small cracks, raveling, and water and air permeability. However, a slurry seal is most often used to correct small surface distresses in older pavements, and to seal the surface of the paved road against further damage. A slurry seal is composed of crushed aggregate, an asphalt emulsion (and fillers), and water, which are mixed according to the manufacturer's instructions.

There are three types of aggregate used in slurry seals: Type I (fine), Type II (general), and Type III (coarse). Type I aggregate is used for slurry sealing in low traffic areas, and the fine texture is useful for maximum crack penetration. Type II are the most commonly used aggregates, used in areas of moderate to heavy traffic. Type III aggregate is used in areas where there are severe surface conditions, and provides friction and resistance for heavy traffic loads.

Special equipment is required for slurry seals; a slurry mixing unit with an attached spreader box will be necessary to ensure proper application. The slurry mixture is laid down as a coating on the paved roadway as the mixer/spreader is moved forward. Again, as a method of preventative maintenance, slurry seals do not offer structural improvements, but rather extend the service life of the road by five to seven years.

Micro-surfacing

Micro-surfacing is another convenient and cost-effective form of preventative maintenance for road repair. Micro-surfacing is a cold-mix asphalt mixture with added polymer modifiers, used to repair small distresses on paved roads.

Just like the slurry seal, micro-surfacing is made from a mixture of aggregate, an asphalt emulsion, and water. However, micro-surfacing also has additional materials, such as advanced polymers and other additives. These additional materials give micro-surfacing added capabilities that slurry seals do not have. The added polymers allow micro-surfacing to be used on high volume roads—roads that typically have around ten to fifteen thousand cars on them per day. Urban arterials are usually suitable for micro-surfacing.

Just like the slurry seal, micro-surfacing also requires special equipment: the micro-surfacing mixture is fed into a spreader box, which evenly spreads the mixture over one lane of paved road in a single pass. The edges of this mixture are automatically textured, and once injected with water, the micro-surfacing mixture is allowed to "cure" on the roadway. Only about one hour is necessary before the paved road can be opened back up for travel.

Micro-surfacing application can occur during a variety of temperature and weather conditions, and can be applied at night as well. This flexibility is particularly useful for high-volume roads, as it means that the paving season is lengthened significantly. Micro-surfacing is generally accepted as extending the service life of the road for over seven years.

Thin Asphalt Overlays

The final method for preventative maintenance in pavement preservation programs is thin asphalt overlays. Thin asphalt overlays are useful for any paved road with minor distress, such as raveling or light cracking that originates on the pavement surface.

Thin asphalt overlay is a hot mix asphalt mixture of asphalt cement and aggregate, spread in a layer ¾ to 1 ½ inches thick over paved roads. Because the overlay is thin, the liquid asphalt layer binds the aged surface of the paved road together, and provides a strong but flexible new surface. Overlays typically last ten to fifteen years, and do bring a small structural benefit to the paved roads. Additionally, thin asphalt overlays restore skid resistance and ride quality, and also can reduce noise pollution on noisy pavement.

Road managers should not use thin asphalt overlays to correct widespread structural damage. Instead, road managers should spread thin asphalt overlays on the road surface before significant damage occurs. Like all of the treatments used in pavement preservation, overlays are solely intended for preventative maintenance.

Routine Maintenance

Routine maintenance is any day-to-day, routinely scheduled work that serves to maintain and preserve a paved roadway condition, or to restore the roadway to an adequate level of service. Routine maintenance on a paved roadway includes roadside ditch and structure cleaning and maintenance, upkeep of pavement markings, pothole repair, and crack filling.

Other maintenance activites, such as corrective or catastrophic maintenance, or pavement reconstruction, are not considered a part of pavement preservation programs, because they are performed after serious damage has occurred to the paved road.

Routine maintenance help keep the paved road in serviceable condition, and aid in pavement preservation programs.

Pavement Rehabilitation

The goal of pavement rehabilitation is to extend the service life of a paved road and/or improve road strength and load carrying capacity. Rehabilitation practices extend pavement life by eliminating pavement cracks or by increasing the thickness of existing pavement in order to strengthen it.

Pavement rehabilitation is divided into two categories that represent these two practices: minor and major regabilitation.

Minor Rehabilitation

Minor rehabilitation involves non-structural repairs that are intended to eliminate cracks due to age and environmental exposure. Minor rehabilitation activities such as these are considered to be part of pavement preservation because they are non-structural in nature.

Major Rehabilitation

Major rehabilitations, on the other hand, are structural repairs that intend to extend the life of pavement. These do not qualify as part of a pavement preservation program, as they are structural enhancements.

Pavement preservation programs that make use of the preventative maintenance techniques outlined above provide long lasting protection for municipalities' paved roads. Studies show that for every $1 spent on preventative maintenance and pavement preservation, the municipality saved $6-$8 on costly reconstructions and rehabilitations later.

Effective pavement preservation programs, in which the roadway undergoes preventative maintenance to stop damage before it occurs, are a cost-effective and safe alternative to allowing roadways to deteriorate until it is absolutely necessary to reconstruct them. By selecting the right treatment for the right road at the right time, municipalities can ensure that their roadways are long-lasting and in good condition continuously.

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