Architecture, Engineering, and Construction Division

Asphalt, Site Concrete,

and Pervious Concrete Maintenance Guidelines

The latest version of this document is available to Church Employees and Consultants on the AEC Website without needing a password:

* <https://aec.churchofjesuschrist.org/design_guidelines/>: Select and download *Asphalt, Site Concrete and Pervious Concrete Maintenance Guidelines* under “CIVIL”.
* The template can also be directly downloaded using this hyperlink: [*Asphalt, Site Concrete, and Pervious Concrete Maintenance Guidelines*](https://aec.churchofjesuschrist.org/design_guidelines/SupportDocs/Asphalt_Site_Concrete_and_Pervious_Concrete_Maintenance_Guidelines.docx).

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with questions or suggestions for improvement.

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All previous versions of this document are obsolete.

Contact AEC with questions, feedback, or suggestions for improvement.

Salt Lake City, Utah

**Asphalt, Site Concrete, and Pervious Concrete Maintenance Guidelines**

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Asphalt, Site Concrete, and Pervious Concrete Maintenance Guidelines

## General

These guidelines have been developed to help facilities managers, project managers, consultants and contractors maintain and extend the service life of asphalt, site concrete, and pervious concrete. They address questions that are frequently asked about the design, installation, and maintenance of these surfaces. They should be used together with the *“Meetinghouse Quality Standards”* and the standard specifications. It is important to maintain site elements to extend their useful life, but it is also important to not unnecessarily increase maintenance costs by “over-maintaining” site elements.

New Asphalt Installation and First Seal

## General

Principle: New paving systems must be properly designed and installed for them to provide many years of service with minimal maintenance. The site adapt team should include a qualified civil engineer and a recent geotechnical evaluation report prepared by a qualified geotechnical engineer. The recommendations and requirements of the report are incorporated into the contract documents. Paving systems should be designed, installed, and maintained to last forty years (minimum). Standard specifications are edited to meet project specific requirements. The paving specification is edited to match a locally available and successful mix.

Remediation of unsuitable soils should be addressed in the contract documents.

* The geotechnical evaluation report should be developed using the [*Geotechnical Evaluation Report Template*](http://aec.churchofjesuschrist.org/aec/design_guidelines/SupportDocs/Geotechnical_Evaluation_Report_Template.docx)located on the AEC Website.

### Penetrating Seals on New Asphalt Paving

A penetrating seal should be placed on new paving, excluding patches. Ideally this would occur between twelve and eighteen months after the asphalt paving has been placed. This allows the asphalt paving to “cure” and “stabilize”. However, to accommodate construction schedules, a penetrating seal may be applied no sooner than one month after the paving has been placed, provided the asphalt has cured sufficiently for the seal to be effective.

* Curing Notes:
  + Verify with the seal manufacturer that application of the seal on new asphalt is acceptable.
  + Paving should be allowed to cure for at least thirty days at 70-degree Fahrenheit temperatures prior to application to allow concentrations of oils on the paving surface to dissipate. Longer cure times of up to sixty days, and even longer, may be needed. The new asphalt must not exhibit ribboning, crawling nor show oil rings when clean water is poured onto the surface.
  + To determine if the surface oils have dissipated, pour one or two gallons of clean water over the pavement surface. If the water sheets out, uniformly wetting the surface and no oil rings appear, the surface is ready to be sealed. If the water balls up and/or shows signs of oil rings, additional curing time is required.

A penetrating seal should be used as the first seal on new asphalt because it will not chip, crack, flake, peel, crack, or craze. A penetrating seal, unlike an emulsion seal, does not provide a new layer of material that can become unbonded from the newly placed asphalt.

Replacement of Existing Asphalt Paving

Principle: Keep the paving in service as long as is economically feasible, before considering replacement.

Before replacing paving at a meetinghouse, engage a geotechnical engineer to perform testing of the asphalt and the soils below the asphalt. The geotechnical engineer should use the [*Geotechnical Evaluation Report Template*](http://aec.churchofjesuschrist.org/aec/design_guidelines/SupportDocs/Geotechnical_Evaluation_Report_Template.docx) to create the report. The template provides important Owner criteria and requirements. Details in geotechnical evaluation reports will vary from project to project, but they should always include:

* Description and extent of problems
* Photographs of the parking lot keyed to a plan
* Findings
* Life-cycle analysis and costs for different options
* Recommended option and conclusions

It is important to examine and compare different options when considering whether to replace paving. Here are a few options that might be worth considering:

* Do as little as possible but keep the pavement in service. This would include not repairing cracks or applying seals. Potholes would be repaired but no other maintenance is provided. Installing new paving is delayed until the condition of the asphalt becomes intolerable. This is sometimes referred to as the “do nothing approach”.
* Full-depth reclamation (FDR): The asphalt paving is demolished and mixed into the existing aggregate base and subgrade. The cost is often 2/3 to ¾ of that for full removal and replacement. Mixing cement in with the demolished asphalt gives additional stability and strength to the soils. Until standard specifications are developed, the site adapt team will need to provide them.
* Pervious concrete: If new, expensive detention/retention basins are required by the authority having jurisdiction, the use of pervious concrete might be a valid option. CAUTION: do not use pervious concrete in areas of freeze/thaw cycles and deicing salts.

Where surface drainage is revised during development of contract documents, the design team should show existing and finish contour lines, and spot elevations for critical points on the flow line and drainage structures (i.e., gutters, catch basins, etc) so that interpolation of contours is not necessary to check field work on the drawings. Any subsurface water problems should be remediated. Refer to the [*United States & Canada Design Guidelines*](http://aec.churchofjesuschrist.org/aec/design_guidelines/AECDesignGuidelines.pdf?t=2018_3_5_10_43) for more information.

Asphalt Maintenance

## General

Principle: Maintaining paving systems is significantly less expensive than replacing paving systems. A consistent program of scheduled maintenance will maximize, extending for many years, a paving system’s useful life.

As it ages, asphalt paving will suffer from environmental distresses such as oxidation, raveling and weathering, block cracking, longitudinal cracking, and transverse cracking. Providing seals and repairing cracks will mitigate these problems. Proper maintenance will prevent the passage of water through the paving into the soils below.

Facilities managers should inspect and maintain existing paving per the *“Meetinghouse Quality Standards”.* They should develop a maintenance plan for each meetinghouse which includes repairing cracks and applying appropriate seals at regular intervals.

* Facilities managers counsel and work with experienced and qualified design professionals, asphalt maintenance contractors, or other personnel, including facilities managers and project managers to determine the best strategy for maintaining asphalt paving.
* The frequency for repairing cracks, applying seals and the type of seals to be used, depends on climatic conditions and the condition of the asphalt paving. A combination of different seals will be used over the life of the asphalt paving.

By synchronizing crack repairs, seals and restriping, maintenance costs can be reduced. Standard specifications available for asphalt maintenance include:

* *Asphalt Based Penetrating Seal* (Section 32 0113.01)
* *Asphalt Based Emulsion Seal* (Section 32 0113.02)
* *Slurry Seal* (Section 32 0113.03)
* *Bonded Overlay with Fabric: Marshall* (Section 32 0113.04)
* *Bonded Overlay with Fabric: Superpave* (Section 32 0113.05)
* *Chip Seal* (Section 32 0113.06)
* *Fog Seal* (Section 32 0113.07)
* *Refined Coal Tar Emulsion Seal* (Section 32 0113.08)
* *Asphalt Paving Crack Seal* (Section 32 0117.01)
* *Asphalt Paving Crack Fill* (Section 32 0117.02)
* *Asphalt Paving Repair: Full Depth Patch* (Section 32 0118.00)
* *Pavement Markings* (Section 32 1723.00)

### Asphalt Maintenance Record

A sample excel spreadsheet, [*Asphalt Paving Maintenanc Record - Sample*](https://teams.churchofjesuschrist.org/sites/MFD/ResourceLibrary/Record%20for%20Asphalt%20Parking%20Lot%20Maintenance.xlsx), is available on the AEC Website at <http://aec.churchofjesuschrist.org/aec/design_guidelines/> which can be used for scheduling maintenance. The spreadsheet helps record past maintenance work and helps to schedule future maintenance work.

### Asphalt Maintenance Checklists

[*Asphalt Maintenance Checklists for Facilities Managers and Contractors*](http://aec.churchofjesuschrist.org/aec/design_guidelines/SupportDocs/Asphalt_Maintenance_Checklists_for_Facilities_Manager_and_Contractor.docx) was developed to help ensure that asphalt maintenance contractors adhere to the specifications, and they should be provided to them for that purpose. The checklists can be obtained from the AEC Website (<http://aec.churchofjesuschrist.org/aec/design_guidelines/>). Note that the contractor is required by the specifications and the checklists to provide the owner’s representative with the amount of material used.

### Maintenance Agreements, Scopes of Work and Costs

#### General

Scopes and costs are determined the year before the work is to be performed and are entered in the annual plan. In the year work is to be performed, and prior to bidding the project, the scope and costs are reviewed and adjusted as needed. The work should be bid following the area approved process.

* A person knowledgeable about asphalt maintenance and asphalt maintenance costs should provide the proposed scopes of work and costs. This could include facilities managers, project managers, architects, landscape architects, civil engineers, and asphalt maintenance contractors. The owner’s representative reviews the proposed scopes of work and costs.

#### Agreements In Areas Where Master Agreements Are Not Used

Proposed scopes of work and project costs are created using Attachment A at the end of one of the asphalt maintenance agreement templates. These templates are found in the MFD Resource Library:

* *Agreement for Asphalt Maintenance CN*
* *Agreement for Asphalt Maintenance US*

#### Master Agreements

Under the direction of the Area, the Materials Management Department/Purchasing Division has set up and maintains regional master agreements with asphalt maintenance contractors in some locations of the United States with negotiated pricing. In these locations, the negotiated pricing applies to any asphalt maintenance work being performed.

* Proposed scopes of work and project costs are determined using Attachment B of the appropriate master agreement. Contact your RFM for information on which master agreement to use and where to obtain a copy.

Note that the incomplete, un-negotiated, master agreement templates used by the Materials Management Department/Purchasing Division to negotiate master agreements with preferred maintenance contractors are found in the MFD Resource Library.

* *Master Agreement for Asphalt Maintenance CN*
* *Master Agreement for Asphalt Maintenance US*

## Crack Repair

Principal: Cracks in asphalt paving need to be sealed to reduce infiltration of water through the asphalt and into the soils below. Repair cracks on an annual to biannual basis.

Duration: Crack fill will last between one and two years. Crack seal will last between three and eight years. The primary difference between crack sealing and crack filling is that cracks are routed when crack sealing.

### General Information

* Crack repair should be done with hot poured asphalt sealant to facilitate the crack being repaired again in the future. The sealant should be of an asphalt-based material, not of a polyurethane or silicone-based material.
* Cracks, including the seams between the asphalt and the concrete curbs/gutters, should be repaired annually or biannually (cracks less than 1/8 inch (3 mm) wide do not need to be repaired). They are to be clean and dry prior to being repaired. Cleaning and drying are essential steps, because when a crack is not clean and dry, the sealant will not adhere to the sides of the asphalt paving. Most failures of crack repair occur because of a loss of adhesion between the sealant and the vertical faces of the asphalt paving due to dirt and loose particles.
* The best time to repair cracks is when the ambient temperature is between 45 degrees and 65 degrees Fahrenheit (7 degrees and 18 degrees Celsius) and when the cracks are at their widest (early spring and late fall) and the sealant can most easily penetrate the crack.
* Soil sterilant should be used if the cracks contain weed and other live vegetation matter.
* In general, many cracks or severely deteriorated cracks indicate a pavement in an advanced state of decay. Crack sealing or filling in these circumstances is both uneconomical and technically unsound, as it does little to delay the need for more extensive corrective actions.

### *Crack Fill* (Specification Section 32 0117.02)

Crack filling is the placement of material into nonworking (inactive) cracks. Crack filling is more predominant than crack sealing, but the repairs do not last as long as crack sealing.

### *Crack Seal* (Specification Section 32 0117.01)

Crack sealing is the placement of materials into nonworking (inactive) cracks or into working (active) cracks. Cracks are routed when crack sealing. Routing creates a sealant reservoir, a channel or trough, with smooth, uniform edges. This allows the sealant material to better adhere to the asphalt paving.

## *Full Depth Asphalt Patch* (Section 32 0118)

Principal: Replace small areas of asphalt paving that are deteriorated or damaged beyond what surface seals can repair. These would include areas of alligator cracking (closely spaced cracks resembling alligator skin), pavement depressions, wheel track rutting, pavement slippage and corrugations.

The need to use a full depth patch often indicates damage to the aggregate base and subgrade soils, often because of subsurface water. If there is damage, the base and soils need to be repaired or replaced before the full depth patch is installed. The help of a geotechnical engineer may be needed to determine whether the existing base and soils are acceptable.

If hot-mix is not available, an appropriate cold mix, specialty mix, or proprietary mix can be used. State Department of Transportation maintenance divisions are a useful source of information regarding specialty and proprietary mixes.

For patches of up to about 3,000 square feet (280 square meters), site adapt standard specification Section 32 0118 – ASPHALT PAVING REPAIR: Full Depth Patch. Do not use fibers in patches. For larger areas, site adapt standard specification Section 32 1216.01 – ASPHALT PAVING: Marshall Method or Section 32 1216.03 – ASPHALT PAVING: Superpave Method.

Soil sterilant should be used if the area of the patch contains weeds and other live vegetation matter.

## Asphalt Overlays

### *Bonded Overlay with Fabric: Marshall* (Section 32 0113.04)

### *Bonded Overlay with Fabric: Superpave* (Section 32 0113.05)

Principle: Overlays are corrective maintenance. It is a layer of new asphalt paving over the existing asphalt paving. Fabric is placed between the existing asphalt paving and the new overlay. Overlays are most common in warmer climates.

Asphalt overlays are used if extensive maintenance, or even replacement, of the asphalt paving would otherwise have been required. Overlays are sometimes used to re-level asphalt paving. Standard milling (traditional milling) is used to remove a portion, one to two inches of the deteriorated asphalt. Existing structural damage, such as cracks, are then repaired before installing the asphalt overlay.

## Surface Seals

### Penetrating Seals

#### *Asphalt Based Penetrating Seals* (Section 32 0113.01)

Principle: Asphalt based penetrating seals are used to replenish and rejuvenate dry and brittle asphalt of both new and old asphalt paving surfaces. They will seal small cracks up to 1/8 inch (3 mm) wide, seal small surface voids, and inhibit raveling caused by oxidation. Penetrating seals waterproof the asphalt, regardless of its condition. Penetrating seals use solvents to drive “maltenes” back into the surface of the asphalt.

Duration: An asphalt based penetrating seal will last between four and seven years.

Disadvantages of a penetrating seal include:

* Obvious pavement flaws may still show through the seal and cracks wider than about 1/8 inch (3 mm) must be repaired before the seal is applied.
* They require longer periods of time to dry, up to about 24 hours, although this varies with specific products.
* They can remain “tacky” and be tracked into the building. Tracking can be resolved by broadcasting a light layer of sand on top of the seal during application. This will help speed up the drying process and help to create a non-skid surface.

#### Coal Tar Based Penetrating Seals

Principle: For these guidelines, refined coal tar based penetrating seals have the same purposes, advantages, disadvantages, and longevity as an asphalt based penetrating seal. Coal tar based penetrating seals have been around for several decades and are undergoing additional developments.

Using coal tar based penetrating seal needs to be done with some caution. Coal tar based penetrating seals are not totally compatible with asphalt-based seals. Avoid applying a coal tar penetrating seal over an existing asphalt-based seal unless that seal is completely worn out or is about ten years old. It can be difficult to successfully place new coal tar seals over existing asphalt-based seals, and vice versa. Once a coal tar seal has been used for maintenance, it is best to continue using coal tar seals for the life of the paving. If an asphalt-based seal has been used in the past, it is usually best to continue using asphalt-based seals.

### Emulsion Seals

#### General

Principle: Applying an emulsion seal is preventive maintenance. An emulsion seal is emulsified asphalt (or refined coal tar) mixed with dry silica sand. The purpose of the sand is to keep the parking surface from becoming slippery. It is used to seal the asphalt paving surface and to also seal hairline cracks. Emulsion seals can be applied to just areas of the paving that need it. For instance, an emulsion seal could be applied to the drive aisles but not the parking areas if it is not needed.

Duration: The standard specifications are set up with the intent that an emulsion seal lasts five years and longer.

An emulsion seal should be used before a slurry seal or a chip seal is used, although this depends upon the condition of the asphalt pavement. An emulsion seal would be used on asphalt without any, or with some minor, surface deterioration. A slurry or chip seal would be used when more aggressive corrective maintenance is needed due to more significant surface deterioration.

An emulsion seal is not intended to, and does not, provide a new wearing surface. An asphalt-based emulsion seal is usually applied as two thin coatings placed separately at 90 degrees to each other although some acceptable products can be applied as a single coat.

The purposes of an emulsion seal are to seal the surface and prevent water from penetrating into the aggregate base and subgrade. It will seal cracks that are 1/8 inch (3 mm) or less in width. It will fill and plug small voids and bond loose aggregate particles. It will help prevent oxidation, aging, and cracking of the asphalt paving. It will enrich, renew, and restore the surface of the asphalt paving and will also inhibit raveling caused by oxidation and aging of the asphalt surface.

Emulsion seals must be applied in conditions outlined in the standard specifications. If not, emulsion seals can “flake off” and fail. Conditions that can lead to “flaking” and failure include:

* Installing the seal without a tack coat on “old,” weathered asphalt. Note that tack coats, which are used with asphalt based but not coal tar-based seals, are generally not needed on asphalt paving between six and twenty-four months old.
* Installing the seal on wet, cold, or dirty asphalt. The existing asphalt should be dry, warm, and clean.
* Using “low grade material” products. The standard specifications list a few acceptable products but there are other products on the market that meet the standard specification’s product criteria requirements.

Once a coal tar seal has been used for maintenance, it is probably best to continue using coal tar seals for the life of the paving. If an asphalt-based seal has been used in the past, it is usually best to continue using asphalt-based seals.

#### *Asphalt Based Emulsion Seals* (Section 32 0113.02)

An emulsion seal placed at 30 gallons of undiluted material per 1,000 square feet (280 square meters), which is required by the standard specification unless arranged otherwise with the owner’s representative, should last five years and longer. The following can be used as an additional guide when site adapting the standard specification:

|  |  |  |  |
| --- | --- | --- | --- |
| **Paving Condition1** | **Undiluted Gallons per 1,000 Square Feet** | **Square Feet of Coverage per Undiluted Gallon** | **Undiluted Gallons per**  **1 Square Yard** |
| Smooth | 20 | 50 | .18 |
| Medium | 30 | 33 | .27 |
| Rough | 40 | 25 | .36 |
| Very Rough | 50 | 20 | .45 |
| 1. Unless decided otherwise, assume a “medium” paving condition. 2. The emulsion seal is diluted per the manufacturer’s instructions and varies from product to product and the time of year the product is placed. The dilution will range from about 5% to 20%. | | | |

Some advantages of using an asphalt-based emulsion seal are that it is less expensive than a slurry seal and provides a smoother texture. It will seal small cracks less than 1/8 inch (3 mm) wide.

Some disadvantages of using an asphalt-based emulsion seal are that most pavement flaws show through the seal and cracks larger than 1/8 inch (3 mm) wide need to be repaired before applying the emulsion seal. The emulsion seal will need between twenty-four and forty-eight hours to dry.

#### *Refined Coal Tar Emulsion Seals* (Section 32 0113.08)

Refined coal tar emulsion seals are more resistant to water, gas, oil, and other chemicals than asphalt-based emulsion seals. They are also highly resistant to ultraviolet light bleaching. Where refined coal tar emulsion seals are available and allowed by the authority having jurisdiction, they may be used. In some areas, they are less expensive and more readily available than asphalt-based emulsion seals. Despite their advantages, their future availability may become a problem because current trends are moving away from their use. The use of refined coal tar emulsion seals is decreasing across North America.

* Some areas do not allow the use of refined coal tar emulsion sealers due to environmental concerns. The installers of refined coal tar emulsion seals must wear splash resistant goggles, protective gloves, and clothing, and use respirators. Asphalt based emulsion seals are more “user friendly,” almost odorless, and do not irritate and burn the skin.

### *Slurry Seals* (Section 32 0113.03)

Principle: A slurry seal is used when an emulsion seal would not be adequate. Slurry seals are used to seal the asphalt surface and to seal hairline cracks (cracks less than 1/8 inch (3 mm) wide). It will help replace missing aggregate at the top surface of raveled asphalt paving. It will plug voids and bond loose aggregates. It will inhibit oxidation and raveling of the asphalt surface and provide a new rejuvenated wearing surface. It replaces some of the lost aggregates at the surface of the asphalt paving.

Duration: Typically, five to seven years.

A slurry seal is applied as a heavier overlay than an emulsion seal. Slurry seals must be applied in favorable conditions that are outlined in the standard specifications. If not, the slurry seal can “flake off” and fail. Conditions that can lead to “flaking” and failure include:

* Installing the seal on old, weathered, and otherwise unsuitable asphalt.
* Installing the seal on wet, cold, or dirty asphalt. The existing asphalt should be dry, warm, and clean.
* Using “low grade material” products.
* Not compacting the slurry seal after it has been placed. Compaction aids in creating a bond between the slurry seal and the existing asphalt.

The standard specifications provide options for three slurry seal types:

* Type I is used for maximum crack penetration and provides a fine textured surface. It also makes an excellent pretreatment for an asphalt overlay or a chip seal. It is usually used in low-density traffic areas such as parking areas, or shoulders where the primary objective is sealing. It is about 1/8 inch (6 mm) thick.
* Type II is the most widely used gradation, although Type I is normally used for parking areas. It provides a medium textured surface. It is used to correct severe raveling caused by oxidation and to improve skid resistance. It is used for moderate (medium) traffic, depending on the quality of the aggregates available and the design. It is about 1/4 inch (6 mm) thick.
* Type III is used to correct surface conditions and provides a highly textured surface. It is sometimes used as the first course in multicourse applications for heavier traffic, and to provide skid resistance. Use this only on old, weathered, oxidized, and raveled asphalt paving. It is about 3/8 inch (9 mm) thick.

Some disadvantages of a slurry seal are that it is more expensive than an emulsion seal. Reflection cracks from the asphalt below will usually telegraph into the seal. Cracks larger than 1/8 inch (3 mm) need to be repaired prior to applying a slurry seal. It is susceptible to power steering tearing and sometimes loses “chips” or “flakes,” especially when new. It needs between twenty-four and forty-eight hours to dry. The default of the standard specification is to require rolling, which will improve its durability.

### *Chip Seals* (Section 32 0113.06)

Principle: Chip seals are used to seal the asphalt surface and to seal hairline cracks. It is corrective and restorative maintenance. Chip seals are sometimes used instead of slurry seals but slurry seals, as used on asphalt parking lots, have mostly replaced chip seals. Chip seals are sometimes used as a “last ditch effort” to avoid asphalt replacement.

Duration: Typically, five to seven years.

A chip seal consists of a sprayed application of asphalt binder to the asphalt paving surface which is immediately covered by single layer of uniform-size aggregate. It is then compacted. The goal is to have the aggregate particles approximately fifty to seventy percent embedded in the asphalt binder. A fog seal (flush coat) is installed over the embedded aggregate. A chip seal is used as a wearing and waterproofing course that improves skid resistance. A chip seal is also known as a “bituminous surface treatment”.

A fog seal can be applied over an existing chip seal as part of a regular maintenance program. It is applied every three to five years as the aggregate “chips” begin to ravel.

CAUTION: A portion of the chips will become unbonded from the chip seal and will need to be swept up. Sometimes, these chips will clog storm water removal systems. If storm water flows into catch basins and underground storm water removal systems, it is best to not use a chip seal.

### *Fog Seal* (Section 32 0113.07)

Principle: A fog seal is a light spray application of asphalt binder applied to the surface of a chip seal (as part of a regular maintenance program) or a weathered asphalt paving surface. A fog seal provides some crack sealing, reduces oxidation and raveling, and enriches and seals asphalt surfaces. Penetrating seals, emulsion seals, slurry seals, or chip seals should be used if more aggressive corrective maintenance is needed.

Duration: A fog seal will last between one and three years.

The purposes of a fog seal are to seal minor cracking, those less than 1/8 inches (3 mm) wide and to seal the asphalt surface. A fog seal will also plug voids and bond loose aggregate particles. A fog seal will also help inhibit oxidation, raveling, and cracking.

A fog seal is less expensive than other seals, but it does not last long. A fog seal will flow easily into cracks and surface voids. A fog seal dries quickly, between one and three hours, depending upon the climate.

Some disadvantages of a fog seal are that most pavement flaws will show through the seal, and cracks larger than 1/8 inch (3 mm) wide need to be repaired prior to the fog seal being installed. A fog seal does not replace lost aggregate and should not be used as a surface treatment for raveling. It can create a slippery surface. A fog seal must be applied more frequently than other seals.

## Miscellaneous Maintenance Methods

### Concrete Overlay

A concrete overlay can sometimes be less expensive than removing and replacing asphalt paving but will be more expensive than an asphalt overlay. It is placed as a 3” to 6” thick overlay and is used where there is severe surface distress. It should not be used where the aggregate base or subgrade soils have failed. It can be applied as an overlay on curbs and gutters.

### Hydro-Blasting

The crack repair material and seals are removed with high pressure water after which the cracks are repaired and a new seal, such as an emulsion seal, or a slurry seal is applied. Hydro-blasting should remove 95% of the existing crack repair material and seals.

### Micro-Milling (Surface Milling)

When crack repair material has built up into near “speed bumps” and seals have accumulated but perhaps flaking off, micro-milling can be used to remove the existing seals and crack repair material; and possibly the top ¼” to ½” of the existing asphalt. The crack repair material and seals are removed with fine tooth milling after which the cracks are repaired and a new seal, such as an emulsion seal or a slurry seal is applied. Micro-milling should remove 95% of the existing crack repair material and seals.

Micro-milling (surface milling) uses a mill drum with more teeth and at a tighter lacing to create a smoother surface than a standard miller used as part of preparation for an overlay. The teeth are spaced about 1/5 inches apart. The ridge to valley depth can be as low as 3 to 4 millimeters. Micro-milling, instead of standard milling, should be used if old surface seals are being removed in preparation for a surface seal.

## *Pavement Markings for Asphalt and Concrete* (Section 32 1723.00)

Principle: Existing pavement markings should be removed prior to application of a chip seal, a slurry seal, or an overlay. The standard specifications allow the contractor to decide how to remove the paint markings. They can be removed by water blasting, grinding, shot blasting, or a combination of preferred methods.

The facilities manager will assess whether existing pavement markings should be removed prior to application of a penetrating seal, an emulsion seal, or a fog seal. When pavement markings are not removed, additional maintenance problems can be created (cracking of the seal or the overlay). The pavement markings usually are not of concern if they are only one layer in thickness. If the paint markings are not removed, they may need to be painted over with black acetone-based paint so that they are not visible through the new seal when not placed in the same location.

Acrylic paint, often called acrylic latex, should be used, and applied per the standard specification. It can be applied as a single wet coat of thirteen to fifteen mils to new and existing pavement surfaces, and to surface seals. The final thickness will be eight to nine mils. It has several advantages over oil/solvent-based paints. These advantages include:

* Superior adhesion
* Flexibility
* Breathability
* Washability
* Opacity
* Color retention.

Acrylic pavement marking paint can be applied immediately to new asphalt paving. It will not react with the asphalt paving, will not cause asphalt cracking adjacent to paint stripes, and will not cause general deterioration of the asphalt surface beneath the paint. The standard specification requires the use of rapid drying paint (five to ten minutes) and allows acetone-based paints.

Oil/solvent-based pavement marking paint should not be used and some jurisdictions are beginning to disallow their use because of the volatiles. Sometimes oil/solvent-based paint is less expensive than acrylic latex paint, but oil/solvent-based paint can lead to asphalt maintenance problems, such as cracks in the asphalt forming adjacent to the paint stripes and general deterioration of the asphalt surface beneath the paint. Do not apply oil/solvent-based paint to new, uncured asphalt paving. The cracking and deterioration of the asphalt paving when oil/solvent-based paint is used can often be attributed to:

* Applying paint to new, uncured asphalt paving
* Paint shrinkage during drying (solvents weaken the asphalt paving)
* Using slow drying paint on new, uncured asphalt paving rather than fast drying paint
* Solvent evaporation
* Temperature difference between light colored paint and dark colored asphalt paving

## Additional Asphalt Maintenance References

* *“Meetinghouse Quality Standards* “when evaluating asphalt paving.
* Standard asphalt maintenance specifications found on the AEC Website (<http://aec.churchofjesuschrist.org/aec/>). The standard specifications are to be site adapted by the design team for individual projects.
* Attachment A of the *Agreement for Asphalt Maintenance US* or the *Agreement for Asphalt Maintenance CN*. Attachment A can be used for scoping and budgeting for the following year’s work.
* [*Asphalt Maintenance Checklists for Facility Managers and Contractors*](http://aec.churchofjesuschrist.org/aec/design_guidelines/SupportDocs/Asphalt_Maintenance_Checklists_for_Facilities_Manager_and_Contractor.docx). These checklists help ensure that the contractor adheres to the requirements of the asphalt maintenance specifications.
* Different sources for asphalt maintenance guidelines, training materials and miscellaneous information for asphalt maintenance are available on the [MFD Resource Library](https://office365lds.sharepoint.com/sites/MeetinghouseFacilities/Library.aspx). For instance:
  + PowerPoint Presentation - [*Installing, Maintaining, and Avoiding Asphalt Replacement*](https://teams.churchofjesuschrist.org/sites/MFD/ResourceLibrary/Asphalt%20Asphalt%20Installation,%20Maintenance,%20and%20Replacement.ppt)
  + eLearning Course - [*Maintaining Asphalt Paving at Church Facilities*](http://lds.netdimensions.com/ldslive/servlet/ekp?CID=LDS933&TX=FORMAT1&BACKTOCATALOG=Y)

Site Concrete Maintenance

## General

Principle: Well-designed and installed site concrete requires little maintenance. None the less, a maintenance plan for each meetinghouse should be developed.

## *Concrete Paving* (Section 32 1313)

The life of concrete paving systems can be extended by providing proper maintenance, when needed.

Offsets should be repaired. The following is from 2010 ADA Standards, Section 303.3:

* Changes in level of ¼ inch (6.4 mm) are permitted.
* Changes in level between ¼ inch (6.5 mm) high and ½ inch (13 mm) high maximum shall be beveled with a slope not steeper than 1 vertical to 2 horizontal (1:2).
* Changes in level exceeding ½ inch (13 mm) must comply with 2010 ADA Standards, 405 (Ramps) or 406 (Curb Ramps).

Cracks should be repaired. If control and/or construction joints have been sealed, the sealant needs to be maintained. Use standard specification section 07 9213 - Elastomeric Joint Sealants for sealant requirements.

## Concrete Scaling

A frequent problem occurring with site concrete is scaling of the top surface, especially if the concrete mix, placement, finishing, or curing was of low quality. Most often, scaling is the result of poor concrete finishing practices. Scaling is a problem that is exacerbated in areas subject to freeze/thaw cycles and deicing salts, especially magnesium chlorides.

Deicing salts used to melt ice on exterior concrete surfaces can cause destructive scaling on unsealed concrete surfaces especially where:

* The concrete compressive strengths are less than about 4,000 psi (27.58 MPa).
* The concrete is less than about one year old.
* The concrete placing methods create a ‘weak’ top surface (use of steel tools, overworking, finishing while bleed water is on the surface, adding water, etc.).
* Excessive amounts of deicers are used or where more corrosive deicers, such as magnesium chlorides, are used. Magnesium chlorides can cause damage to existing concrete surfaces that are not, or were not, damaged by less aggressive deicers.

New patches over scaled areas can be used. However, they are undependable and often fail within a few years of placement. Sometimes, diamond grinding of the top surface layer will be needed if it is significantly scaled. A seal would be applied after diamond grinding of the surface.

## *Surface Seal* (Section 03 3517)

Concrete sealers as specified in standard specification section 03 3517, silanes, are applied to concrete surfaces to protect them from surface damage, corrosion, and staining. The sealers penetrate the top surface of the concrete. They block pores in the concrete surface to reduce absorption of water and salts and form an impermeable layer which prevents such water and salts from passing. Concrete sealers, when selected and applied properly, will prevent the intrusion of water and deicers, minimizing freeze/thaw damage. The standard specification section also allows the use of linseed oil/mineral spirits sealers.

A concrete sealer should be applied to exterior concrete surfaces in these situations:

* Deicing chemicals will be used within one year of new concrete placement.
* The minimum compressive strength of existing concrete is less than 4,000 psi (27.58 MPa) as determined by non-destructive concrete testing (Swiss hammer).
* When desired by project manager or facilities manager.

A concrete sealer should be applied to exterior concrete surfaces placed in areas of freeze/thaw cycles after about September 1st. The concrete sealer is applied any time after twenty-eight days of placement. This protects concrete against damage caused by deicers, especially more corrosive deicers such as magnesium chlorides during the first winter.

Concrete sealers are not to be used to replace Membrane Concrete Curing. Concrete sealers also should not be confused with ‘polished’ concrete, ‘sealers’ applied to polished concrete, ‘densified’ concrete, ‘hardened’ concrete, ‘stained’ concrete, ‘epoxy’ concrete, or ‘terrazzo’ concrete.

Concrete sealers on exterior concrete are not needed or used in areas not exposed to freeze/thaw cycles and deicing salts.

## Additional Site Concrete Maintenance References

* *“Meetinghouse Quality Standards* “when evaluating existing site concrete.
* Refer to the standard specifications found on the AEC Website (<http://aec.churchofjesuschrist.org/aec/>). Standard specification section 07 9213 - Elastomeric Joint Sealants for sealant requirements and standard specification section 03 3517 – Concrete Sealer Finishing for sealers subject to freeze/thaw cycles and deicer salts. The standard specifications are to be site adapted by the design team for individual projects.
* Additional sources of guidelines, training materials and miscellaneous information for concrete are found on the [MFD Resource Library](https://office365lds.sharepoint.com/sites/MeetinghouseFacilities/Library.aspx). For instance:
  + PowerPoint Presentation - [*Concrete Paving Design, Installation and Maintenance*](https://teams.ldschurch.org/sites/MFD/ResourceLibrary/Concrete%20Paving%20Design,%20Installation%20and%20Maintenance.pptx)
  + PowerPoint Presentation - [*Concrete Paving*](https://teams.ldschurch.org/sites/MFD/ResourceLibrary/Concrete%20Paving.ppt)

Pervious Concrete Maintenance

## General

Maintenance practices and recommendations for pervious concrete are still being developed. It is interesting to note that research indicates that pervious concrete paving that is not maintained still performs very well over time but not at the original infiltration rate.

Maintenance can be provided by sweeping, power blowing, power vacuuming, power washing, or power vacuuming simultaneously with power washing.

* Power vacuuming on a periodic basis, perhaps once a year, is generally enough to maintain the infiltration rate of pervious concrete. Depending on the amount of debris collected on the surface of the pervious concrete, dry power vacuuming once every three years is enough.
* Power vacuuming simultaneously with power washing is 'rehabilitation' and is used when the pervious concrete is severely clogged due to not having been periodically maintained with power vacuuming.  This method would be used on a very infrequent basis.
* Repeated power washing, without power vacuuming, can drive debris and sediments deeper into the pervious concrete that can be difficult to remove and will reduce the infiltration rate of the pervious concrete.

Do not use pervious concrete in areas of freeze/thaw cycles where deicers are used but for pervious concrete already placed, snow removal should be accomplished using a rotary broom or cleared using a plow with a lower edge made of plastic or rubber.

## Maintenance

The following, with the maintenance information above, can be used as a guide in preparing a site-specific maintenance schedule:

* Miscellaneous:
  + Do not use an asphalt seal coat on pervious concrete paving.
  + Do not allow a chip seal or other such material to be placed on or carried onto the pervious concrete paving.
  + If the pervious concrete paving needs to be repaired or replaced, it should be repaired or replaced with pervious concrete.
  + Seed bare upland areas to prevent water and wind-borne sediments from spreading to the pervious concrete paving.
* Soon After Installation:
  + The standard pervious concrete specification requires the pervious concrete installer to provide a written maintenance plan about twenty-eight days after placement of the pervious concrete.
    - A qualified professional should review the pervious concrete paving, per the maintenance plan, to determine if it is functioning properly or if cleaning is necessary.
  + The infiltration rate of the hardened pervious concrete should be determined per ASTM C1701/C1701M-09, ‘Standard Test Method for Infiltration Rate of In Place Pervious Concrete’. This is required as part of the Closeout Submittals. The locations where the tests are performed are to be recorded. This will provide a “base infiltration rate” for future maintenance decisions. Future infiltration tests should be performed at the same locations.
  + The maintenance plan should include recommendations for periodic testing of the infiltration rate per ASTM C1701/C1701M. The plan should provide methods for restoring porosity if the infiltration rate drops below eighty percent of the originally determined rate. It is suggested that infiltration tests be performed once a year for the first three years. The data obtained by keeping a record of the amount of debris removed will help provide information for future maintenance planning.
* Every Month:
  + Ensure that the pervious concrete paving is clean of debris and sediments.  Sweep the surface to keep the surface free of debris and sediment. This is particularly important in harsh environments (such as coastal areas, or anywhere there might be a heavy accumulation of fines).
* Every Year:
  + Inspect the surface for deterioration, raveling, or spalling.
  + Inspect the sealant in the control joints.
  + Inspect for proper storm water drainage.
  + Employ a testing agency to test the infiltration rate per ASTM C1701/C1701M.
    - If the infiltration rate drops below eighty percent of the originally determined rate, provide infiltration maintenance:
* Acceptable methods for restoring the infiltration rate are either to power sweep, power vacuum, or power vacuuming simultaneous with power washing.
* Record the weight of the material removed for planning purposes (five to six pounds (2.3 kg to 2.7 kg) per 1,000 sq. ft. (93 sq. m) is common).
* Classify and record the type of material removed for planning purposes (silt, sand, leaves and so forth).

## Additional Pervious Concrete Maintenance References

* The Pennsylvania Aggregates & Concrete Association (PACA) has created a document that details procedures for maintaining pervious concrete paving. PACA has also developed two videos that demonstrate cleaning and maintaining pervious concrete paving, as well as measuring the in-place infiltration rate of the pervious concrete. These can be found at <http://www.specifyconcrete.org/>under the “Pervious Concrete” tab.
* The National Ready Mix Concrete Association (NRMCA) also has maintenance guidelines available at <http://www.nrmca.org/>