CAPITAL PREVENTIVE MAINTENANCE PROGRAM

GUIDELINES

Approved - January 6, 2000
Engineering Operations Committee

2.02.01

PROJECT IDENTIFICATION AND SELECTION

The performance of a highway depends upon the type, time of application , and quality of the maintenance it receives. Pavement maintenance can be classified into three activity groups which are preventive, reactive, and routine maintenance. ***Preventive Maintenance*** is the planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration and maintains or improves the functional condition of the system without (significantly) increasing structural capacity. In essence, preventive maintenance activities protect the pavement and decrease the rate of deterioration. ***Reactive maintenance*** are activities that must be done in response to events beyond the control of the Department. Some events require response as soon as possible to avoid serious consequences because a present or imminent danger exists. Reactive maintenance cannot be scheduled because they occur without warning and often must be immediately addressed. Examples of reactive maintenance activities include pothole patching, removing and patching pavement blowups, or unplugging drainage facilities. ***Routine maintenance*** is the day-to-day maintenance activities that are scheduled or whose timing is within the control of maintenance personnel. Examples of routine maintenance include filling cracks in pavement, painting pavement markings or cleaning ditches. Delays in preventive maintenance increase the quantity of pavement defects and their severity so that, when corrected, the cost is much greater. Consequently, the life cycle costs of the pavement will be considerably increased.

The purpose of the Capital Preventive Maintenance Program is to protect the pavement structure, slow the rate of pavement deterioration and/or correct pavement surface deficiencies. Emphasis should be placed on life cycle work for both rigid and flexible pavement. A high priority should be given to newly constructed pavement structures. Appropriate preventive maintenance activities should employ life cycle scheduling until repair costs exceed the benefits derived from such activities or until the pavement structure needs to be reconstructed. This may require that preventive maintenance activities be performed on pavements at a more frequent interval than previous guidelines allowed. The basis of preventive maintenance activities should be consistent the Region's overall preservation strategy. Each Region should develop a five-year preventive maintenance action plan for these newly constructed pavement structures.

Project selection for preventive maintenance is now assisted by using data from the Pavement Management System (PMS). Recommended pavement condition levels are listed for each preventive maintenance treatment. These condition levels have been identified to aid the Engineer in determining for what existing pavement condition a specific preventive maintenance treatment is cost effective. Pavement condition data includes Remaining Service Life (RSL), Distress Index (DI), Ride Quality Index (RQI), and Rut Depth. These condition measures are consistent statewide and will insure that preventive maintenance treatment selection for specific projects is consistent with long term network pavement strategies identified by the Department. The application of preventive maintenance treatments should be on pavements with a Remaining Service Life (RSL) of greater than two years. Pavements having less than two years RSL will be a candidate for either a Rehabilitation or Reconstruction Project. Pavement conditions that require immediate attention are ideal candidates for routine maintenance until the R/R is implemented.

Preventive maintenance projects can be performed on any highway under the jurisdiction of the Michigan Department of Transportation. These projects should be relatively simple and should focus on pavement structures with more than 2 years of remaining service life. Severely distressed pavement structures or pavements with a severely distorted cross section are generally not candidate projects for the Capital Preventive Maintenance Program. Project work should be kept between the outside edges of the shoulders or curbs because such a project qualifies for a blanket 3C environmental approval. Minor safety work can be included in Preventive Maintenance Projects, but such work should not be extensive. Examples of minor safety work include; pavement cross section corrections by either milling or by placing a bituminous wedge course, the replacement of blunt and turned down guardrail ending with the new guardrail ending standard, the connection of the guardrail to the bridge rail and/or bridge pier, and the replacement of the existing pavement markings to current standards.

The Capital Preventive Maintenance Program uses mostly surface treatments as categories of work. These surface treatments are targeted at pavement surface defects primarily caused by the environment and by pavement material deficiencies. Occasional structural deficiencies of the pavement structure caused by traffic loading can be corrected by this program. Other preventive maintenance treatments used to protect the pavement structure and/or to slow the rate of pavement deterioration include limited shoulder work and drainage work. The Capital Preventive Maintenance Program includes the following treatments:

Flexible and Composite Pavement Treatments

-Non-Structural Bituminous Overlay
-Surface Milling with Non Structural Bituminous Overlay
-Chip Seals
-Micro-Surfacing
-Crack Treatment
-Overband Crack Filling
-Bituminous Shoulder Ribbons
-Ultra Thin Overlay

Rigid Pavement Treatments

-Full Depth Concrete Pavement Repair
-Concrete Joint Resealing
-Concrete Spall Repair
-Concrete Crack Sealing
-Diamond Grinding
-Dowel Bar Retrofit
-Concrete Pavement Restoration
-Bituminous Shoulder Ribbons
-Open-Graded Underdrain Outlet Cleaning & Repair

All candidate selections consistent with these guidelines will be the responsibility of the Regions. Joint reviews with Lansing Maintenance representation is not necessary, unless requested by the Region. The form, "Proposed Project Field Review Report" (See Chapter 9 - Documentation & Forms), shall be used to document the field review for each candidate project. Personnel from the TSC office will complete the description of the proposed project and the historical data portion of the form before the field review. After the field review, the Preventive Maintenance Coordinator from the Region office will complete the form. The completed form will contain the description of the proposed project, the historical data on the highway section, field review comments and agreements made during the field review. A copy of the completed form will be sent to the Capital Preventive Maintenance Program Administrator in the Maintenance Division.

As an aid to assess the effectiveness of the Capital Preventive Maintenance Program, a yearly field review will be conducted on a representative number of completed projects that employed the various treatments.

FLEXIBLE & COMPOSITE PAVEMENT SURFACE TREATMENT

NON-STRUCTURAL BITUMINOUS OVERLAY

Description: A dense graded bituminous mixture limited to a 90 kg/m^2 application rate.

Purpose: A non-structural bituminous overlay is the highest type of surface treatment fix available in the Capital Preventive Maintenance Program. It will provide some protection to the pavement structure, slow the rate of pavement deterioration, correct many pavement surface deficiencies, improve the ride quality and add some strength to the existing pavement structure.

Existing pavement condition: The existing pavement should exhibit a good base condition and a uniform cross section. The visible surface distress may include moderate raveling, longitudinal and transverse cracks and small amounts of block cracking. Low associated distress may be present. The pavement should only have some minor base failures and depressions.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	Rut
Flexible	**3**	**<40**	**<70**	**<12mm**
Composite	**3**	**<25**	**<70**	**<12mm**

Existing pavement surface preparation: This preparation work should be limited to the repair of the minor base failures and depressions, the filling of voids in the pavement surface, the removal of any patched area with poor adhesion or a very high asphalt content that may bleed up through the new bituminous surface, the correction of severely tented joints and the correction of deficient superelevations, if required.

Performance: This treatment performs best on flexible pavement structures, but is also applicable to composite pavements depending on the extent of the reflective cracking.

Life Extension

Pavement	Years
Flexible	5 to 10
Composite	4 to 9

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: A non-structural bituminous overlay should not be placed on the following existing pavement conditions: severely distressed composite pavement, severely raveling or rutted bituminous pavement, pavement with a weak base, or a bituminous surface that is debonding.

FLEXIBLE & COMPOSITE PAVEMENT SURFACE TREATMENT

SURFACE MILLING WITH NON-STRUCTURAL BITUMINOUS OVERLAY

Description: The removal of an existing bituminous surface by the cold milling method and the placement of a dense graded bituminous mixture limited to a 90 Kg/m^2 application rate.

Purpose: In the Capital Preventive Maintenance Program, the cold milling operation has been used to: (1) correct specific existing surface deficiencies, (2) correct the shape of the existing cross section and (3) produce a more economical project as compared to a non-structural bituminous overlay project. The non structural bituminous overlay replaces the bituminous material that is removed.

Existing pavement condition: The existing pavement should exhibit a good base condition. The visible surface distress may include: severe surface raveling, multiple longitudinal and transverse cracking with slight raveling, a small amount of block cracking, patching in fair condition , debonding surface and slight to moderate rutting.

The cold milling operation is used to correct rutting in the existing bituminous surface layer where the rutting is not caused by a weak base and when the condition of the existing pavement has deteriorated to a point where it is not practical to correct the rutting problem by a more economical treatment. The cold milling operation is also used to remove an existing bituminous course that is debonding.

Existing pavement crown and superelevation sections that have been identified as having a relationship to accidents can be modified by cold milling. Often, only a single lane of the existing cross section needs a preventive maintenance treatment. In these cases, it is more economical to remove the existing bituminous surface in that lane by cold milling and do nothing or do a less expensive fix on the less deteriorated portions of the cross section. In a curb and gutter section, cold milling can be used to remove a portion of the existing bituminous surface to retain the existing curb face. Cold milling can also be used in those areas where the existing pavement grade cannot be raised.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.*	Rut
Flexible	**3**	**<40**	**<80**	**<25mm**
Composite	**3**	**<30**	**<80**	**<25mm**

**Higher R.Q.I. values may be accepted in urban locations if the cause for the poor ride can be corrected.*

Existing pavement surface preparation: None.

Performance: This type of treatment will protect the remaining pavement structure, slow the rate of deterioration and improve the ride quality.

Life Extension

Pavement	Years
Flexible	5 to 10
Composite	4 to 9

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: This treatment should not be used on an existing pavement that shows evidence of a weak base.

FLEXIBLE AND COMPOSITE PAVEMENT SURFACE TREATMENT

CHIP SEAL

Description: A chip seal is the application of a polymer modified asphalt emulsion with a cover aggregate. A single or a double chip seal can be used in the Capital Preventive Maintenance Program.

Purpose: A chip seal will seal and or retard the oxidation of an existing pavement surface, improve skid resistance of the pavement surface, seal fine surface cracks in the pavement thus reducing the intrusion of water into the pavement structure, and will retard the raveling of aggregate from a weathered pavement surface.

Existing pavement condition: The existing pavement should exhibit a good cross section and a good base. The visible surface distress may include slight raveling and surface wear, longitudinal and transverse cracks with a minor amount of secondary cracking and slight raveling along the crack face, first signs of block cracking, slight to moderate flushing or polishing and/or an occasional patch in good condition.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	Rut
Flexible	**5 (double) 6 (single)**	**<30 (double) <25 (single)**	**<54**	**<3mm**
Composite	**5 (double)**	**<15 (double)**	**<54**	**<3mm**

Existing pavement surface preparation: For single chip seals all visible cracks and construction joints should be sealed by the overband crack fill method. On double chip seals all cracks and construction joints greater than twelve inches in length and greater than one fourth of an inch in width should be sealed by the overband crack fill method. When the number of cracks and construction joints to be sealed reach the difference of the cost between a single and double seal, it may be more economical and practical to place a double chip seal in lieu of a single chip seal with overband crack fill.

Performance: Since chip seals are used to seal the cracks and construction joints in the pavement in lieu of extensive stand alone overband crack fill, the life expectancy may vary based on reflective cracking.

Life Extension

Pavement	Years
Flexible:	
Single Seal	3 to 6
Double Seal	4 to 7
Composite:	
Double Seal	3 to 6

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: Chip seals are used only on low volume rural roads and on bituminous surfaced shoulders. Chip seals may perform poorly under moderate to heavy commercial traffic because of aggregate loss and flushing. The construction season for this work is relatively short. Chip seals should not be placed in cool weather. It usually requires about one month of warm weather following construction for the aggregate particles to become reoriented and properly embedded in the asphalt membrane. Application during periods of high temperatures and humidity may cause slow cure and excessive flushing. Loose aggregate not embedded in the asphalt membrane will become airborne and possibly damage windshields of vehicles of the traveling public. Traffic noise will also increase after a chip seal is placed.

FLEXIBLE & COMPOSITE PAVEMENT SURFACE TREATMENT

MICRO-SURFACING

Description: Micro-Surfacing is a mixture of polymer modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, properly proportioned, mixed, and placed on a paved surface.

Purpose: A single course micro-surfacing will retard oxidation and improve skid resistance in the pavement surface. A multiple course micro-surfacing is used to correct certain pavement surface deficiencies including severe rutting, minor surface profile irregularities, polished aggregate or low skid resistance and light to moderate raveling. Micro-surfacing is typically used on flexible or composite pavements and can perform under all traffic volumes

Existing pavement condition: The existing pavement should exhibit a uniform cross section and a good base. The visible surface distress may include slight cracking, rutting, minor surface irregularities, flushed or polished surface and/or moderate raveling.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	Rut
Flexible	**5 (multiple) 10 (single)**	**<30 (multiple) <15 (single)**	**<54**	**<25mm**
Composite	**5 (multiple)**	**<15**	**<54**	**<25mm**

Existing pavement surface preparation: Surface preparation typically includes overband crack fill, bump removal if necessary, removal or protection of raised pavement markers and seal patching for large voids and potholes.

Performance: This treatment corrects rutting, flushing and low friction. A Micro-Surface performs well on high volume roadways to correct the pavement surface conditions described above.

Life Extension

Pavement	Years
Flexible: Single Course Multiple Course	 3 to 5 4 to 6
Composite: We acknowledge that micro surfacing will provide a life extension to a composite pavement, however data is not available to quantify the life extension.	

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: A standard micro-surfacing formulation should not be used on a pavement with moderate to heavy surface cracks. Due to it's brittle nature, it is a poor crack sealer. Early results of new ductile micro-surface formulations appear to perform significantly better on cracked pavements. Micro-Surfacing mixes are very aggregate specific because of the chemically triggered, quick reaction characteristics of the mixture. Because micro-surfacing mixes require warm to moderate temperatures for curing, caution is recommended for late season night time work.

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FLEXIBLE AND COMPOSITE PAVEMENT TREATMENT

CRACK TREATMENT

Description: Crack treatment consist of both crack sealing and crack filling. Crack sealing is attained by the Cut and Seal Method. Crack filling is attained by the Overband Crack Fill Method. The Cut and Seal Method consists of cutting the desired reservoir shape at the working crack in the existing bituminous surface, cleaning the cut surfaces and placing the specified materials into the cavity to prevent the intrusion of water and incompressible into the crack. The Overband Crack Fill Method consists of cleaning the non-working crack in the bituminous pavement surface and placing the specified materials into and above the crack to substantially reduce infiltration of water and to reinforce the adjacent pavement.

Purpose: The purpose of sealing and filling cracks and construction joints in the flexible pavement surface is to prevent water and incompressible from entering the pavement structure.

Existing pavement condition: The existing bituminous surface should be a relatively newly placed surface on a good base and with a good cross section. On a flexible base, the bituminous surface should be two to four years old and on a composite pavement, one to two years old. The visible surface distress may include: fairly straight open longitudinal and transverse cracks with slight secondary cracking and slight raveling at the crack face, and no patching or very few patches in excellent condition.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	Rut
Flexible	**10**	**<15**	**<54**	**<3mm**
Composite	**10**	**<5**	**<54**	**<3mm**

Existing pavement surface preparation: None.

Performance: The effectiveness of the seal will greatly depend upon the width of crack being sealed and the movement of the pavement structure at the crack.

Life Extension

Pavement	Years
Flexible	Up to 3
Composite	Up to 3

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: Generally, all transverse cracks in the traveled lanes should be sealed by the Cut and Seal Method. All other cracks in the traveled lanes and the shoulder areas can be filled by the Overband Crack Fill Method. Transverse cracks that have excessive secondary cracking around the main crack should not be individually sealed. The presence of this type transverse crack is an indication that the pavement surface may warrant a more extensive pavement surface treatment.

This treatment is not a one shot operation. In order to maintain the sealed pavement surface, this treatment should be followed up by a routine maintenance crack sealing or crack filling operations when additional cracks develop.

FLEXIBLE AND COMPOSITE PAVEMENT TREATMENT

OVERBAND CRACK FILLING

Description: The Overband Crack Filling consists of cleaning the crack in the bituminous pavement surface and placing the specified materials into and above the crack to substantially reduce infiltration of water and to reinforce the adjacent pavement.

Purpose: The purpose of overband filling the cracks in the surface of the bituminous pavement is to prevent water and incompressible from entering the pavement structure. This treatment is commonly used as a surface preparation for the Micro-Surface and Chip Seal treatments. Use as a stand alone Preventive Maintenance treatment, due to excess wear or failure shall be limited to older pavement where the cut and seal method is not suitable.

Existing pavement condition: The condition of the existing bituminous surface depends upon the other Preventive Maintenance treatment that Overband Crack filling treatment will be used as a surface preparation. Overband Crack filling should be used to fill all non-working cracks.

FOR STAND ALONE APPLICATION

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	Rut
Flexible	**7**	**<20**	**<54**	**<3mm**
Composite	**7**	**<10**	**<54**	**<3mm**

Performance: This treatment will help extend the service life of the surface treatment it is being used with as a pretreatment. A stand alone overband crack filling will also extend the life of the pavement structure.

Life Extension

Pavement	Years
Flexible	Up to 2
Composite	Up to 2

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: If this treatment is to be used as a stand alone, caution should be taken in the selection of a pavement where there are too many cracks. This treatment may be a good alternative to where the cracks in the pavement have deteriorated just beyond the requirements for a Crack Treatment: too wide, secondary cracks and minor spalling.

FLEXIBLE, COMPOSITE OR RIGID PAVEMENT TREATMENT

BITUMINOUS SHOULDER RIBBONS

Description: This work includes the construction of a new bituminous shoulder ribbon where gravel shoulders exist or the removal and replacement of a deteriorated bituminous shoulder ribbon.

Purpose: The purpose of a bituminous shoulder ribbon is: (1) to accommodate an increasing encroachment of traffic, (2) to expedite runoff water from the traveled lane pavement, (3) to provide other usage such as bicycle paths, (4) to reduce edge stresses and edge and corner deflections by increased lateral support and (5) to reduce the development of pavement edge drop-offs.

Existing pavement condition: In order for this treatment to be used in the Capital Preventive Maintenance Program, the condition of the adjacent pavement structure must meet the Capital Preventive Maintenance Program's pavement condition criteria.

REQUIREMENT

The design life of the shoulder ribbons should be equal to or less than the Remaining Service Life (RSL) of the main line pavement.

Performance: Most shoulder deterioration is attributable to truck encroachment, water intrusion in the longitudinal joint, use of lower quality materials, and inadequate structural thickness. Field observations have shown that shoulder distress is primarily concentrated within 0.6 m from the traveled lane. The extension of pavement life will be up to 3 years.

Performance Limitations: The total thickness of the bituminous shoulder is limited to 180 Kg/m^2. The width of the bituminous shoulder ribbon is usually 1.0 m. This width of the bituminous shoulder ribbon can be increased where it is justified.

FLEXIBLE AND COMPOSITE PAVEMENT TREATMENT

ULTRA-THIN BITUMINOUS OVERLAY

Description: A dense graded bituminous mixture limited to a 49 kg/m^2 application rate and a maximum average thickness of 20mm.

Existing pavement condition: The existing pavement should exhibit a good base condition and a uniform cross section. The visible surface distress may include slight raveling, minor surface irregularities, and slight polished surface. The cross sections should be free of ruts or distortions.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.	Rut
Flexible	**7**	**<20**	**<54**	**<3mm**
Composite	**7**	**<10**	**<54**	**<3mm**

Existing pavement surface preparation: Surface preparation typically includes bump removal if necessary, removal of raised pavement markers and patching large voids and potholes. Placement of an ample bond coat and warm temperatures are key to successful application of an ultra-thin bituminous overlay.

Performance: This treatment performs best on surfaces that are distortion free and exhibit very little crack sealing material that may bleed through the mat.

Life Extension

Pavement	Years
Flexible	3 to 5**
Composite	3 to 5**
***We acknowledge that an ultra-thin bituminous overlay will provide a life extension to a pavement, however data are not available to quantify the life extension.*	

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: An ultra-thin bituminous overlay should be used only on low volume roads that exhibit light distress. The treatment should not be placed over overband crack filling or new seal patch due to the likelihood of bleed through. The ultra-thin should not be used on rutted pavements or pavement exhibiting distortion.

RIGID PAVEMENT TREATMENT

FULL DEPTH CONCRETE PAVEMENT REPAIR

Description: The work consists of complete removal and replacement of the concrete pavement at the deteriorated joint or open crack. The new concrete repair should include load transfer (dowel bars), pavement reinforcement (if JRCP), contraction and /or expansion joints with joint seals.

Purpose: A full depth concrete repair will restore the pavement's structural integrity and should at least maintain it's existing ride quality. Secondary benefits include a reduced amount of water entering the pavement structure and a slower rate of future distress formation.

Existing pavement condition: Overall, the concrete pavement should be in good condition and deteriorating at a slow rate. Transverse joints and cracks to be repaired should show at least 1 meter of moderate to severe spalling over it's length within the lane. Other transverse cracks exhibiting a crack width greater than 7mm or faulting more than 3mm are appropriate for full depth repairs.

Pavement	Minimum RSL (years)*	D.I.*	R.Q.I.**
Rigid	**7**	**<20**	**<54**

*The full depth concrete pavement repair is limited to 19 patches per lane kilometer (30 per lane mile).
**Higher R.Q.I. numbers should consider Concrete Pavement Restoration.

Performance: The time period from casting to intended opening to traffic should be a minimum of 3 days.

Life Extension

Pavement	Years
Rigid	3 to 10

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: Concrete repairs will usually induce a variation in tire noise from a difference in surface texture between the repair and the existing pavement. If a calcium chloride accelerator is used for faster strength gain, then the anticipated longevity of the repair will be reduced by approximately 50%. In general, the longevity of the repair will be reduced when strength gain is accelerated from normal rates using Grade P1 concrete.

RIGID PAVEMENT TREATMENT

CONCRETE JOINT RESEALING

Description: This work includes the removal of the existing joint seals, and resealing the transverse and longitudinal joint with either preformed neoprene, silicones, or low-modulus hot-poured rubber.

Purpose: The purpose of resealing the concrete pavement joints is to prevent water and incompressible from entering the pavement structure, thus slowing the rate of deterioration of the concrete pavement.

Existing pavement condition: Resealing with neoprene can be done when the concrete pavement is fairly new and typically used where pourable sealants have failed. Joint faces must be in good condition with very little to no spalling. Joints should not be open more than 25mm at any temperature throughout the year. Joint widths should not vary by more than 4mm.

Resealing with silicones is typically done on older concrete pavements (more than 10 years old). Self-leveling silicone can be used in joints where spalls are less than 25mm deep and less than 38mm wide (as measured from the joint face). Non-sag silicone can be used in joints where spalls are less than 38mm wide (as measured from the joint face). If spalls exceed these limits, joint spall repair must be done in order to use silicones. Caution should be used when using silicones on pavement containing carbonate or slag aggregates.

Low-modulus hot-poured rubber is an option for resealing concrete pavements containing carbonate and slag aggregate. It's movement capabilities are lower than silicone so cutting the joints wider may be necessary. Low-modulus hot-poured rubber should be used when resealing longitudinal joints.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.
Rigid	**10**	**<15**	**<54**

Performance: A properly placed concrete pavement seal should benefit the service life by slowing the deterioration rate of the concrete pavement.

Life Extension

Pavement	Years
Rigid	3 to 5

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

RIGID PAVEMENT TREATMENT

CONCRETE SPALL REPAIR

Description: The work is to repair spalled concrete by removing all unsound concrete, cleaning the area, and placing a filler material consisting of a fast-set mortar or a rapid setting polymer concrete. Spalling may occur along transverse or longitudinal joints, cracks, or be located somewhere on the pavement surface. Filler materials are typically pre-packaged and are placed according to recommendations from the supplier. Use of a filler material should be verified from the Department's Qualified Products List.

Purpose: Spall repair is done to remove distress from the pavement and to increase the life of the repair versus typical reactive methods that use temporary asphaltic filler or cover materials.

Existing Pavement Condition: The amount of spalling needs to be quantified to make an accurate estimate of the project cost, as spall repair is relatively expensive. Project cost should be compared with other PM treatments to judge overall cost effectiveness. The cause of spalling should be determined to assure the repair will be long-lasting. Pavements that exhibit signs of material related distress (ie: D-cracking or Aggregate Silica Reactivity) are not suitable candidates for spall repair.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.
Rigid	**10**	**<15**	**<54**

Performance: The department has limited performance experience with spall repair methods and filler materials. The process is evolving, as research continues both within Michigan and nationally. Specifically, the types and usage of filler material is changing the most. The Department has developed a special provision for spall repair that is customized depending on the location of the spall. From observations and evaluations performed to date, successful performance is highly dependent on the effort to produce a proper condition for the filler material. This involves thoroughly preparing the area, which includes removal of all unsound concrete or old patching material, removal of reinforcement, if exposed, and non-durable aggregate (ie:popouts), or foreign material originally entrapped in the concrete. The dimensions of the repair area need to address the potential for shrinkage of the filler material, which may induce loss of bond with the surrounding pavement concrete.

Life Extension

Pavement	Years
Rigid	Up to 5

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

RIGID PAVEMENT TREATMENT

CONCRETE CRACK SEALING

Description: Crack sealing involves the sawing or routing, cleaning and sealing of cracks in the concrete pavement that are greater than 305mm in length and greater than 3mm in width. If the crack is greater than 10mm in width a backer rod must be used.

Purpose: The purpose of sealing the cracks in the concrete pavement is to reduce the water and incompressible from entering the pavement structure and thus slowing the deterioration rate of the pavement.

Existing pavement condition: Concrete pavement that exhibit a slow rate of deterioration should have a high priority for crack sealing. Subsequent Preventive Maintenance crack sealing projects should follow every five years or until the condition of the pavement requires extensive work that is beyond the scope of the Capital Preventive Maintenance Program.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.
Rigid	**10**	**<15**	**<54**

Performance: Crack sealing should help slow the deterioration rate of the concrete pavement. This treatment is best used in conjunction with other treatments of rigid pavements such as joint resealing and minor spall repair and /or full depth concrete joint repair. The benefit from sealing concrete pavements with open graded drainage course and underdrains has not been determined.

Life Extension

Pavement	Years
Rigid	Up to 3

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

RIGID PAVEMENT TREATMENT

DIAMOND GRINDING

Description: This work consists of diamond grinding the entire lane width as specified on the plans.

Purpose: Diamond grinding is used to restore the surface longitudinal profile and crown of a concrete pavement that provides an improved ride quality. Benefits from diamond grinding include: the removal of joint and crack faults, the removal of wheel ruts caused by studded tires, the restoration of transverse drainage, and the improvement of skid resistance. If appropriate, only one lane of a multi -lane roadway can be improved by diamond grinding.

Existing pavement condition: The existing pavement should exhibit a uniform cross section and a good base. The visible surface distress may include joint and crack faults not exceeding 6mm, rut depths less than 6mm, moderate to severe polishing, or not over twenty five percent scaling of the surface area.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.
Rigid	**12**	**<10**	**>54**

Existing pavement surface preparation: Diamond grinding should not be viewed as a one step solution to treating the concrete pavement surface. Often other repairs should be performed prior to diamond grinding. Diamond grinding should be considered when the average ride quality index (RQI) is greater than 54, average friction number is 30 or less, or there are more than 30 full depth repairs per kilometer.

Performance: The reduced impact loading caused by diamond grinding should significantly extend the pavement service life. Faulting at the joints and cracks may return after several years of service to the condition prior to diamond grinding. This will depend on several factors, including the joint efficiency of the pavement and the amount and quality of concurrent concrete pavement treatment work. The improved skid resistance due to diamond grinding depends on the final micro texture and macrotexture and the hardness and polishing characteristics of the aggregates. The improved skid values will decline until they reach the skid levels of the original surface at which point the values will generally remain steady.

Life Extension

Pavement	Years
Rigid	3 to 5

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: Diamond grinding should generally not be used on concrete pavements where the faulting is greater than 6mm. Greater fault depths will greatly increase the unit cost of diamond grinding. As mentioned above, diamond grinding should not be used as a one step solution to treating the deficiencies of the concrete pavement.

RIGID PAVEMENT TREATMENT

DOWEL BAR RETROFIT

Description: Dowel bar retrofit is an operation in which slots are cut into the concrete pavement across faulted joints and cracks, and dowel bars are placed in the slots to restore the load transfer. The work consists of five operations: cutting the slots, preparing the slots, placing the dowel bars, backfilling the slots and opening the pavement to traffic.

Purpose: A dowel bar retrofit treatment restores the effective load transfer at faulted joints and cracks, significantly reduces the recurrence of faulting and increases the structural capacity of the pavement.

Existing pavement condition: This treatment should be used to rehabilitate existing jointed concrete pavements in good to fair condition before serious deterioration is present. There should be very little to no spalling along the joint or crack. Crack widths should be less than 7mm and faulting less than 3mm.

Pavement	Minimum RSL (years)	D.I.	R.Q.I.
Rigid	**10**	**<15**	**<54**

Performance: This treatment should generally be used with other rigid pavement treatments such as diamond grinding, to extend the service life of existing jointed concrete pavements. Joint resealing or concrete crack sealing may also be necessary on pavements with poorly draining bases.

Life Extension

Pavement	Years
Rigid	2 to 3

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: If serious faulting at the existing cracks and joints in the concrete pavement is present, this should not be used as a stand alone treatment. Base problems must be addressed.

RIGID PAVEMENT TREATMENT

CONCRETE PAVEMENT RESTORATION

Description: This work shall include full depth concrete pavement repairs and diamond grinding. A combination of additional treatments, including spall repair, dowel bar retrofit, crack sealing and joint resealing, can provide substantial benefit to the pavement.

Purpose: Most projects will require several treatments used in combination to correct existing distresses. The treatments not only repair distress, but also prevent or slow the recurrence of distress.

Existing Pavement Conditions: The concrete pavement will likely display deterioration that requires a combination of various treatments. The key is to select a repair strategy that considers costs, longevity and future maintenance and reconstruction options. Generally, roadways considered for concrete pavement restoration have 3 to 7 years of Remaining Service Life (RSL).

Pavement	Minimum RSL (years)	D.I.	R.Q.I.
Rigid	**3**	**<40**	**<80**

Performance: A proper application of treatments to correct deficiencies will result in longer lasting concrete pavements. Additionally, the work will result in greater public consciousness of the improvements. If the pavement condition requires more than 44 full depth concrete repairs per lane kilometer, a rehabilitation or reconstruction alternative approach may be more cost effective.

Life Extension

Pavement	Years
Rigid	7 to 15

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: If a calcium chloride accelerator is used for faster strength gain, then the anticipated longevity of the repair will be reduced by approximately 50%. In general, the longevity of the repair will be reduced when strength gain is accelerated from normal rates using Grade P1 concrete.

RIGID PAVEMENT TREATMENT

OPEN-GRADED UNDERDRAIN OUTLET CLEANING AND REPAIR

Description: This work includes the clean out and repair of the rigid PVC, corrugated plastic or steel open-graded underdrain outlets from outlet ending to the connection with the mainline open-graded underdrain.

Purpose: The installation of an open-graded drainage system improves the long term load carrying and load distribution properties of the base, subbase and subgrade materials by removing the free water which can decrease the stiffness of these load carrying layers. The clean out and repair of the open-graded underdrain outlets will help re-establish the effectiveness of the open-graded underdrain drainage system.

Existing pavement condition: The clean out and repair of open-graded underdrain outlets should begin on a rigid pavement that is approximately ten years old. Subsequent Preventive Maintenance clean out and repair projects should follow every ten years or until the condition of the pavement requires extensive work that is beyond the scope of the Capital Preventive Maintenance Program.

Performance: The clean out and repair of the open-graded underdrain outlets will help re-establish the effectiveness of the open-graded underdrain drainage system thus maintaining the load carrying capacities of the base, subbase and subgrade.

Performance Limitations: Since this work will be done by contract, it is necessary to define the work to be done in the contract and provide a relatively accurate plan quantity. As in the past, there shall be no overruns of contract costs on Preventive Maintenance projects. Therefore, the open-graded underdrain outlets to be cleaned and repaired shall be accurately located and identified in the project plans. Requiring the contractor to explore for the open-graded underdrain outlets shall not be included in the Preventive Maintenance Projects because such work can not be accurately identified and quantified. The underdrain outlet repair work will be limited to work perpendicular to the roadway.