# Chapter 4

# Concrete Pavement Program

## 4.0 Introduction

**Description**

Maintenance plays an essential and integral role in the long-term life of a concrete pavement. Pavement left to deteriorate without timely maintenance treatment will likely require more costly treatments sooner than those properly maintained. This chapter covers those activities and maintenance treatments for concrete pavements (PCC). These include the following:

- Temporary patching of PCC pavements
- Permanent patching of PCC Pavements
- Shoulder repairing
- Crack and joint sealing and contracted crack and joint sealing
- Grinding
- Mud jacking

**Purpose**

Montana Department of Transportation's goal is to maintain concrete pavements in a manner that provides a safe roadway, to preserve and extend the state's investment, to maintain the functional condition and to retard future deterioration.

**Pavement Management**

Pavement maintenance is classified by function as either reactive or preventive. The difference between the two is the condition of the pavement at the time the treatment is applied.

Preventive maintenance treatments preserve rather than improve the structural capacity of the pavement. Preventive maintenance treatments are limited to only those pavements in good conditions. Montana Department of Transportation's pavement system identifies crack and joint sealing as preventive maintenance.

The goal of reactive maintenance is to maintain the roadway until the construction program can reconstruct or rehabilitate the project. Generally, temporary patching, permanent patching, mud jacking and grinding are used as a reactive maintenance treatment.

When developing a concrete pavement program, the following factors should be considered:

- Budget limitations (balance future budgets).
- Optimization of both preventive and reactive maintenance available funds.
- Coordination with adjacent construction projects.
- Preservation of the state's investment.
- Cost/benefits of treatment.

**Pavement Deficiencies**

Pavement deficiencies or distress, which affect safety and have a long-term effect on the pavement and ride quality, should be considered when establishing a maintenance pavement program. The following pavement distresses should be considered:

**Joint Faulting**

This often results when the joint seals fail, which allows water under the concrete slab. Heavy traffic loadings may cause a concrete slab to rock so that fine particles of the underlying material may be pumped up through the joint creating a void under a slab, causing height differential from adjacent slabs. The preventive measure is to keep joint and cracks sealed to avoid joint faulting and other damage to the pavement.

**Joint Separations**

Joint separation and the loss of joint seal allow water to reach underlying base materials and may result in faulting. Joints in the concrete pavement or between the concrete pavement and the asphalt shoulders should be filled when they exceed ¼ inch (6mm) in width.

**Joint Spalling**

Spalled joints are caused by a joint surface edge breaking, resulting in a hole in the pavement. Surface spalling may be caused by freeze-thaw cycles or by the continued use of metal (such as tire chains) coming in contact with the pavement surface.

The corrective measure for spalled joints is repair using specialized patching materials. Minor surface spalling does not require maintenance. More severe spalling may require temporary patching with asphalt or permanent patching using partial depth concrete patches.

**Slippery Pavement**

When aging and wear cause changes in pavement texture the surface may become slick from moisture or frost. Routine inspection of pavement surface texture should be made and suspected problem areas reported promptly. Diamond grinding is the corrective measure for pavement that has lost its skid resistance.

### Cracks

Cracking of the pavement surface usually occurs because of base material failure, temperature expansion and contraction or excessive loads. Cracks in the pavement allow water and foreign material to enter the structural section and can cause further failure of the pavement.

The corrective measure should be to seal cracks that are 1/8 inch (3mm) wide or when an area has extensive cracking.

### Settlement, Heave, and Distortion

This type of roadbed defect often results in poor riding quality. Typical causes are fill settlement, unstable cuts, expansive soils, unconsolidated basement soils, and insufficient structural section.

Bridge approach slab settlement is included in this category and requires routine inspection. A void often exists under the approach slab long before the slab settles. This type of distress usually requires correction of problems under the concrete pavement such as mud jacking; however temporary repairs may be made by asphalt surfacing to improve the ride quality.

## Purchasing

Arrangement for obtaining the required materials should be made prior to scheduling a project. Developing a **Pavement Preservation Contract** acquiring concrete materials or grinding requires a minimum of two months prior to the project.

Rubberized crack sealant materials are purchased twice a year for each maintenance area. Crack sealant for a contracted crack-sealing project is part of the contract and is not furnished by MDT.

## Safety and Training

Supervisors should review safety, training and work zone requirements with employees and ensure compliance with approved guidelines.

Employees should review Material Safety Data Sheets (MSDS) sheets for products and make themselves aware of safety and health precautions and required personal protective clothing.

## Environmental Best Management Practices

Supervisors should be aware of environmental concerns. Special precautions must be taken to protect water quality near streams, lakes and wetlands. Dispose waste materials at an appropriate site.

**Documentation**
Documentation of these activities should be in accordance with the activity reporting system outlined in the Maintenance Management System Manual. If special documentation is required, it will be included under the applicable activity.

**Resources**

MMS Manual
Fish, Wildlife and Parks, A Guide to Stream Permitting
Montana Safety Policy and Procedures Manual
MUTCD
Work Zone Guidelines
MDT Crack Seal Manual
MDT Chip Seal Manual

## 4.1 Temporary Patching of PCC Pavement (MMS 1101)

### Activity Description

Temporary patching of broken or spalled areas in the roadway surface is performed when weather or time will not permit permanent repairs. Temporary patching is performed using a temporary material such as plant-mixed bituminous surfacing or quick setting mixes.

### Purpose

Temporary patching is used to provide a safe pavement surface, to prevent surface deterioration and to maintain satisfactory ride quality until time and weather permit permanent patching.

### Timing of Maintenance

Temporary patching should begin as soon as practicable after potholes develop. Early spring and periods of wet weather result in the most deterioration.

### Specialized Equipment

- Air compressor with jackhammers, pavement saws or chipping tools to prepare the area.
- Container for carrying and applying the asphalt tack coat prior to placement of the patch.
- Compaction equipment to compact the mix.
- Arrow board and a changeable message sign if available.
- Barrier vehicle and an impact attenuator if available.
- Special equipment may be required to satisfactorily mix and/or apply the epoxy adhesive and rapid setting proprietary patch materials. Check manufacturer's recommendations.

### Materials

Temporary patching materials normally consist of an asphalt product, preferably plant mixed asphalt cement bituminous surfacing, or other material that will perform adequately under heavy truck traffic.

### Safety and Training

Supervisors should review safety, training and work zone requirements with employees and ensure compliance with approved guidelines.

All employees should review all Material Safety Data Sheets (MSDS) to learn about products used and to make them aware of safety and health precautions and required personal protective clothing.

**Special Precautions**
Attention should be given to traffic control, safety of workers and motorists and reduction of disruption to traffic.

**Environmental Best Practices**
Best management practices include:

- Carrying adequate erosion control supplies (diapers, kitty litter, shovels, etc.) to keep materials out of water bodies.
- Disposing excess materials at appropriate sites.
- Performing surface work in dry weather to minimize any runoff of hazardous material when possible.
- Striving to eliminate diesel and solvents as a releasing and cleaning agent by using environmentally sensitive agents if patching with asphalt.

**Procedures**

1. Set up traffic control.
2. Use jackhammers, pavement saws or chipping tools where practical to square up and prepare the patch.
3. Remove loose material from the area that is being patched.
4. Apply the tack coat of emulsified asphalt.
5. Place the patching material.
6. Smooth the patch surface with hand tools. Large patches should be placed and brought to grade using appropriate equipment.
7. Compact with appropriate equipment.
8. Place traffic lane delineation marking materials if required.
9. Remove traffic control.

## 4.2 Permanent Patching of PCC Pavement (MMS 1101)

### Activity Description

Permanent patching requires that the pavement surfacing be maintained true to type; therefore, repairs made with asphalt patching material do not qualify as permanent patches. When broken or spalled areas in the roadway surface are repaired, patching is to be performed using a permanent patch material such as high, early-strength PCC or a rapid setting proprietary concrete product. Permanent patches may be partial or full depth.

### Purpose

The purpose of a permanent patch is to restore damaged or deteriorated areas to near original constructed conditions.

### Timing of Maintenance

Placement of permanent patches should be performed under the following conditions:

- Weather is satisfactory for proper cure of the materials.
- Traffic flow can be restored prior to peak times on heavy volume routes.
- Traffic control can be established so several areas can be patched at a time within one control zone.

### Specialized Equipment

- Special equipment may be required to satisfactorily mix and/or apply the epoxy adhesive and rapid setting proprietary patch materials. Check manufacturer's recommendations.

### Materials

Materials that can be used for permanent patches are somewhat dependent on the extent and type of damage. The most common materials are described below:

- PCC made with high early strength cement may be used for most permanent repairs. In order to obtain a good joint between the old and the new concrete, an epoxy adhesive should be used.
- Rapid setting proprietary products are available for patching concrete surfacing and may provide improved performance over PCC.
- Special products may be required to clean tools after using epoxy adhesive or rapid setting proprietary patch material. Check manufacturer's recommendations.

### Ordering

Arrangements for purchasing patching materials should be made prior to scheduling work. Consult Standard Specification Manual or District/Area material lab for advice on appropriate concrete mix. PCC is normally obtained from a commercial source. Arrangements for delivery of products should be made several days in advance of the scheduled work.

Rapid setting proprietary products are normally obtained in small quantity containers. Product brochures should be obtained to determine the best product for the planned repair.

**Testing**
If small quantities are involved, testing is not required such as mixing several bags of materials. If significant quantities are used such as in slab replacement, prior arrangements should be made with the District/Area Materials Lab to take appropriate samples and tests.

**Storage**
If a rapid setting proprietary product is used, it should be stored in accordance with manufacturers' recommendations.

**Special Handling**
If epoxy adhesive is used as a bonding agent between the old and the new concrete, or if a rapid setting proprietary product is used, these must be handled and applied in accordance with manufacturers' recommendations and the MSDS for the product.

**Safety and Training**
Due to hazards of traffic, work should be confined to one side of the roadway at a time.

Employees should review MSDS to learn about products and to make themselves aware of safety and health precautions and required personal equipment and protective clothes.

**Special Precautions**
When working with epoxy adhesives or rapid setting proprietary patch materials, supervisors should be aware of safety precautions, pot life of the mixed materials and recommended application temperature. On all specialty products, manufacturers' recommendations should be followed precisely.

**Environmental Best Management Practices**
Best management practices include:

- Carrying adequate erosion control supplies (diapers, kitty litter, shovels, etc.) to keep materials out of water bodies.
- Disposing excess material at appropriate sites.
- Performing surface work in dry weather minimizing runoff of potentially hazardous material.

**Procedures**

1. Set appropriate traffic control devices.
2. Cut the perimeter of the patch with a concrete saw.

3. Take care not to disturb the cement-related base or other base concrete pavement in a full depth patch. In most cases, the slab can be removed in one piece and broken up outside of the patch area so a loader or backhoe can handle the debris.
4. Clear loose material from the area being patched.
5. Ensure patch meets strength requirements.
6. Remove traffic control.

**Patching with Portland Cement Concrete**

1. Apply epoxy adhesive materials to surfaces of old concrete.
2. Place concrete mixture using tamping or vibratory equipment.
3. Screed patch even with surrounding concrete.
4. Broom fresh concrete to provide texture.
5. Place concrete curing seal.
6. Clean tools used for epoxy and concrete before the material sets.
7. Place traffic lane delineation tape, if required.
8. Ensure the material has cured sufficiently.
9. Complete any other patching within the traffic control zone.
10. After the patch meets strength requirements, remove traffic control.

**Patching with Rapid Setting Proprietary Patch Material**

1. Apply bonding agent.
2. Place patch materials.
3. Screed patch even with surrounding concrete.
4. Broom fresh concrete to provide texture.
5. Place curing seal if recommended by material manufacturer.
6. Clean tools used for the bonding agent and the rapid setting product before the material sets.
7. Place traffic lane delineation tape if required.
8. Complete any other patching with the traffic control zone.
9. Remove traffic control.

## 4.3 Paved Shoulder Repair (MMS 1101,1102)

### Activity Description

This activity covers patching and/or repairs of paved asphalt shoulders adjacent to a concrete roadway. This may include repaving, asphalt patching or slurry sealing, using rejuvenation materials, chip sealing and/or cold planing.

### Purpose

The purpose of performing shoulder repair is to

- Minimize the vertical edge differential between the concrete and the asphalt pavements for the safety of motorists.
- Provide a reasonably uniform surface for emergency use.
- Prevent further deterioration of asphalt shoulders.
- Maintain a uniform roadway cross section for drainage.

### Timing of Maintenance

Repair work on the shoulder areas should be accomplished when weather conditions permit the tack coat to break and placement of a thin lift of plant mixed bituminous surfacing.

### Specialized Equipment

- Cold planer
- Paver (contracted or department provided)
- Rut-filler
- Slurry seal applicator
- Distributor (contracted or department provided)
- Chip Sealer

### Materials

- Plant mixed asphalt bituminous surfacing.
- Premixed liquid asphalt bituminous surfacing (slurry seal).
- Emulsified liquid asphalt for tack coats and seal and cover.
- Rejuvenation products.

#### Ordering

Preliminary arrangement for purchasing patching materials from a commercial source should be made prior to scheduling the work.

### Safety and Training

Because of hazards of traffic, work on asphalt-paved shoulders should be confined to one side of highway at a time. Work on the paved shoulder normally requires closing the adjacent traffic lane.

Employees should review MSDS to learn about products used and to make themselves aware of safety and health precautions and required protective equipment and clothes.

**Environmental Best Management Practices**
Best management practices include:

- Striving to eliminate diesel and solvents as releasing or cleaning agents by using environmentally sensitive cleaning and releasing agents.
- Carrying adequate erosion control supplies (diapers, kitty litter, shovels, etc.) to keep materials out of water bodies.
- Disposing of excess material at appropriate sites
- Performing surface work in dry weather, minimizing runoff of potentially hazardous material.

**Procedures**
These are the procedures for placing bituminous material for paved shoulder repair:

1. Set up traffic control devices. Procedures should be compatible with the activity being performed.
2. Refer to specific activity description treatments outlined in Chapter 3 for treatment selected.
3. Remove traffic control by reversing the process used to set up the control.

## 4.4 Crack and Joint Sealing (MMS 1103)

### Activity Description

This activity includes the preparing and sealing of joints and cracks in concrete pavement, and the longitudinal joint between concrete pavement and asphalt paved shoulders.

### Purpose

Joints and cracks are sealed to prevent deposits of incompressible materials such as sand and other fine debris in the concrete-asphalt joints, and to prevent water from getting under the concrete surfacing.

### Timing of Maintenance

PPC roadways should be monitored routinely to determine when crack sealing would be appropriate. Timing of this activity depends on the type of joint sealing material. Repairs should be made while the cracks are the widest due to contraction of the concrete and asphalt to reduce the possibility of material being pulled out of the joints by hot tires. When rubberized asphalt is used, it should be placed when the pavement is dry and above freezing. Any materials should be placed in accordance to the manufacturer's recommendations. (Reference: Crack-Sealing Manual).

### Specialized Equipment

- Mechanical router for routing the cracks is required on all preventive maintained projects.
- Air compressor with nozzle to clean and dry cracks, with at least 100 CFM and 125 PSI.
- Hot air lance for drying the crack (optional).
- Pot or kettle capable of heating rubberized sealant to 400° F.
- Broom or blower to clean roadway.

### Material

The joint between the concrete pavement and asphalt should be filled with rubberized asphalt crack filler.

Silicone is the preferred sealant for concrete-to-concrete joints or cracks. (Reference: Crack-Sealing Manual)

**Ordering**
Rubberized asphalt crack filling material is normally ordered in truckload lots twice a year through a term contract twice a year.

- **Storage**
  Rubberized crack sealant materials should be stored in a covered area. For a short period, it may be stored outdoors. Caution should be taken to ensure the product is not contaminated. Covered storage minimizes slumping of the materials, which occurs when it is stored in the sun for an extended period of time.

## Training and Safety

Because of hazards of traffic, work should be confined to one side of highway at a time.

Employees should review the MSDS to learn about the product and to make themselves aware of safety and health precautions and required personal protective equipment and clothing.

**Special Precautions**
Supervisors should review MSDS for products prior to use to determine if special handling is recommended or required. Since rubberized crack sealant is placed at a very high temperature (over 380° F) this activity requires special precautions:

- Ensure first aid supplies are on the job site.
- Be careful of hot material splashing when filling the pot or kettle.
- Keep the crack-filling kettle outside in an open area when heating.
- Attend at all times the crack-filling kettle while heating.
- Perform daily safety inspections of the hose through which the material is applied.
- Be cautious when using the hot air lance due to high temperatures.
- Wear appropriate personal protective gear.

## Environmental Best Management Practices

Best management practices include:

- Striving to eliminate diesel and solvents as releasing or cleaning agents by using environmentally sensitive agents.
- Carrying adequate erosion control supplies (diapers, kitty litter, shovels, etc.) to keep materials out of water bodies.
- Disposing of excess material at appropriate sites.
- Performing surface work in dry weather, minimizing runoff of potentially hazardous material.

## Procedures

The following procedures are for placing **rubberized** crack/joint sealing materials.

1. Purchase crack sealant through semi-annual contract. Obtain sufficient crack sealant material for the day's production.

2. Check to ensure the pot or kettle is in good working condition.
3. Heat the crack filling material prior to the scheduled work.
4. Set up traffic control devices, assign flaggers, and where appropriate, use arrow boards, shadow vehicles and changeable message signs.
5. The pavement mat temperature must be at least 35° F. (2 °C.) and no more than 120° F (49°C) during the routing and crack sealing process.
6. All working cracks between 1/8inch (3mm) and 1inch (25mm) will be routed to 1½ inch (40mm) by 3/8 inch (10mm) deep (4 to 1). The walls (sides of the routed reservoir) shall be vertical and the bottom flat. Cracks greater than 1 inch wide do not require routing and backer-rod may be necessary. However, all other parts of these guidelines shall apply. Nonworking longitudinal cracks may use other crack sealing techniques and materials.
7. All cracks shall be clean and free of dirt, dust, or other loose material with the air compressor before the sealant is applied. All routed reservoirs or cracks left unsealed overnight shall be cleaned and dried before the sealant is applied.
8. The routed reservoir will be filled flush with the pavement surface (not band-aided). Do not overfill and keep the material from being spread widely on the pavement surface. Use a U shaped squeegee or special tip on the filler tube to level material. Both the roadway and the sealed reservoirs shall be free of moisture. Both the roadway and the routed reservoir shall be free of moisture for a minimum of 1 hour before the sealant is applied.
9. Use a blotter material, if necessary, to eliminate tracking. Toilet paper (biodegradable), soap and water, or Glenzoil, may be used as a blotter.
10. Clean up the area, pick up all empty containers.
11. Remove traffic control by reversing the process used to set up the control.

The following procedures are for placing silicone crack filling material:

1. Place appropriate traffic control.
2. Remove old joint sealant material.
3. Resaw joints to the width and depth specified.
4. Clean joints by sand blasting.
5. Clean joints with compressed air.
6. Place backer rod.
7. Place and level silicone. If the self-leveling type is not used, silicone should be approximately ¼ inch (7mm) below the surface of the pavement.
8. Clean up area.
9. Remove traffic control.