

## APPENDIX B

### GUIDELINES FOR IDENTIFYING AND REPAIRING LOCALIZED AREAS OF DISTRESS IN AC PAVEMENTS PRIOR TO CAPITAL PREVENTIVE MAINTENANCE OR REHABILITATION REPAIRS

#### I. Background Information

##### A. AC Pavement Distress Terminology and Definitions

###### 1) AC Pavement Cracks

###### a) Alligator Cracks

Alligator cracking is characterized by interconnected or interlaced cracks in the wheel path, forming a series of small polygons, (generally less than 1 foot on each side). The cracking resembles the appearance of alligator skin, thus the term alligator cracking. Alligator cracking is a load-related distress and occurs when the wheel loads exceed the design of the roadbed.



b) Longitudinal Cracks

[Shrinkage Cracks, Reflection Cracks, Joint Cracks, Edge Cracks and Slippage Cracks]

Longitudinal cracks are non-load-associated cracks. Longitudinal cracks are single cracks approximately parallel to the centerline. These cracks are primarily due to the contraction and shrinkage of the surface course, reflection from underlying pavement joints, poorly constructed paving joints, or roadbed settlement.



c) Transverse Cracks

Transverse cracks are non-load-associated cracks. Transverse cracks appear approximately at right angles to the centerline. These cracks are primarily due to the contraction and shrinkage of the surface course or reflection from underlying pavement joints.



## 2) AC Surface Distortions

### a) Rutting

Rutting is a longitudinal surface depression in the wheel path caused by the consolidation in the asphalt surface layer or lateral movement in one or more of the layers of roadbed material under heavy loads.

### b) Shoving

Shoving is localized displacement or bulging of pavement material in the direction of loading pressure. Shoving is often associated with bleeding or over rich asphalt mix.

### c) Settlement

Settlement is a noticeable or abrupt vertical distortion from the original pavement profile or cross-slope. Settlement is often associated with fill areas. This condition may also have associated cracking, Settlement Cracking.



### 3) Asphalt Disintegration

#### a) Pot Holes

Potholes are isolated, bowl-shaped holes in the pavement of various sizes. Generally, potholes are a result of the loss of alligatored pavement and, if so, they can be irregular in shape due the adjacent alligatored pavement. They frequently appear when maintenance is not promptly applied once the distress that is causing them appears.



b) Raveling

Raveling is caused by the action of traffic on a weak surface. Raveling of a weak surface course is generally due to insufficient binder in the mix. Raveling is different than weathering, which is caused by climatic conditions that result in a drying out of the pavement surface. "Coarse Ravel" is the wearing away of the pavement surface, resulting in an extremely roughened surface texture. This rough surface texture is due to the dislodging of coarse aggregate and loss of the asphalt binder. "Fine Ravel" is the wearing away of the pavement surface asphalt and fines, resulting in a moderately roughened surface texture. This roughened surface texture is due to the wearing away of fine aggregate and asphalt binder. Coarse Ravel is characterized by an extremely rough and pitted surface. Fine Ravel is characterized by a moderately rough surface.

## **B. Patching Repairs**

1) Types of AC Distress that Require Patching Repair

- Potholes
- Alligator cracking
- Pavement depressions (settlement)
- Wheel track rutting
- Pavement slippage cracks
- Corrugations

2) Types of Patching Repairs

In general, the repairs required to fix the distressed AC area(s), as listed in B.1, consists of removing the existing asphalt concrete surfacing and underlying base, subbase and native material, as necessary. Then, replacing the removed layers with either full-depth asphalt concrete or a combination of asphalt concrete and aggregate base.

There are two types of patches used to repair asphalt pavements:

- Partial Depth (patching less than 4 inches thick and contained within the asphalt surface); and,
- Full Depth or Deep Patching ("dig outs" at least four inches thick and, as necessary, removal of additional material beneath the asphalt surfacing).

Dig outs require more time and effort and are more expensive than surface patching. However, it is important to remember that if a patch is to solve the problem, it must be done properly with the proper techniques and materials.

## **II. Field Identification Procedures and Analysis of Localized Areas of Distress**

### **A. Determining the Location(s) Needing Repair and the Extent of the Repair**

A field review of the project site needs to be conducted to locate the specific areas of severe distress. These locations can be identified by loose or spalling pavement and/or rutting greater than 0.05 ft (15 mm). If the failed areas that require to be dug-out are close together, then the adjacent areas to "good" pavement should also be considered for removal and replacement; to combine the failed areas into a larger area to be replaced for constructibility reasons.

## B. Analyzing the Distressed Location and Determining the Depth of the Repair

The depth of the repair required depends on several factors:

- **The severity of the failure.**  
For example - Usually, the more severe the pavement surface failure is, the deeper the removal of materials.
- **The type and depth of the existing base.**  
For example - If a portion of a thin bound base is removed, the remainder will provide little support. Therefore, the entire treated base should be removed.
- **The compaction of the underlying material.**  
For example - One indication of weak subsoil is commingling, which is the migration of the base rock down and the fines of the soil up. If the probe penetrates more than about 0.20 feet into the subsoil, then increase the depth of the dig out an additional 0.25 feet.

*(dig and probe to investigate) If the evidence indicates that there is a base failure, then both the AC pavement and base should be removed until firm or compacted material is reached. Probing the base with a conical-shaped pointed metal rod (soil probe) should be done. The probe should not penetrate more than about 0.10 ft.. In cases where an existing "dig out" area has lost its integrity, it may be necessary to design the replacement as new construction, i.e., based upon the appropriate R-value. Examination of the base and subbase as the material is removed is necessary to determine the required depth of removal.*

## C. Assessing the Cause(s) for the Distress and Recommending a Repair Technique

The cause of the distress at each distressed area must be determined before a correct remedy can be applied. In general, the cause of the distress will determine the extent of the repair procedure. After removing the pavement surface, the appearance of the base should not show any deformation or evidence of fine materials loss. If the pavement surface is broken and water has entered the subgrade, a larger failure most likely has resulted. Typical causes for the various types of AC distress are as follows:

### 1. Potholes

Potholes typically are the result of localized asphalt disintegration under traffic. A pothole is usually caused by weakness in the pavement resulting from too little asphalt, too thin an asphalt surface, too many fines, too few fines, or poor drainage. Potholes frequently appear when it is difficult, because of inclement weather, to make permanent repairs. Temporary repairs usually involve cleaning out the hole and filling it with a premixed asphalt patching material.

Recommended Repair: Permanent repair is made by constructing a partial depth or deep patch that completely removes the affected area and replaces it with new AC and base materials, as necessary.

### 2. Alligator Cracking

Alligator cracking is probably caused by a saturated base or subgrade. Therefore, correction should include removal of the wet material and installation of needed drainage. When water is a factor in the cracking, drainage should first be corrected.

Recommended Repair: Permanent repair is made by constructing a deep patch that completely removes the affected area and replaces it with new

AC and base materials, as necessary. Hot mix asphalt placed full-depth provides a strong patch and can be done expeditiously. If hot mix asphalt is unavailable or is not needed to quickly complete the repair or not needed for constructibility purposes, new aggregate base material compacted in layers and capped with AC pavement may be used.

### 3. Pavement Depressions (Settlement)

Settlement in localized areas of limited size is sometimes accompanied by cracking. When water collects in these depressions, they become not only a source of pavement deterioration but also a hazard to motorists.

Depressions are caused by traffic loads heavier than that for which the pavement was designed, by poor construction methods, or by consolidation deep within the subgrade. Edge cracks and depressions can also be caused by the lack of lateral or shoulder support for the asphalt pavement.

Shoulder edge cracking typically occurs when the natural or imported shoulder backing material is eroded away from the edge of pavement. Traffic, water, wind, or settlement of the underlying material may cause this erosion. Edge cracking usually happens as a drop-off condition develops and is characterized by crescent-shaped cracks or fairly continuous cracks parallel to, and usually within 1" to 2" of, the outer edge of pavement.

Asphalt without proper lateral support will eventually break away, resulting in higher maintenance costs and loss of the facility. Shoulder edge loss occurs when the lateral support is not sufficient to protect the edge of pavement and repeated wheel loads chip the unbacked asphalt away.

Recommended Repair: When water is a factor in causing the depression, drainage should first be corrected. The depressions should then be removed, repaired by constructing a deep patch that completely removes the affected area and replaces it with new AC and base materials, as necessary, and then compacted to restore the area to the same grade as the surrounding pavement. Hot mix asphalt placed full-depth provides a strong patch and can be done expeditiously. If hot mix asphalt is unavailable or is not needed to quickly complete the repair or not needed for constructibility purposes, new aggregate base material compacted in layers and capped with AC pavement may be used.

### 4. Wheel Track Rutting

Instability within the AC pavement without a base failure will cause wheel path rutting and adjacent ridges to be shoved up. Such things as too little compaction of the pavement, too many fines or round or smooth textured coarse aggregates in the mix, too much asphalt in the mix can cause a lack of stability and this distress in the asphalt surface. The surface probably will not show any pumping of fines from the base layer, but the excess asphalt tends to migrate to the surface of the pavement with high temperatures. Alligator cracking may be present but the cracks will be hairline in width.

Rutting can also be caused by problems in the lower layers of the structural section. Rutting can also be caused by traffic loads heavier than that for which the pavement was

designed, by poor construction methods, by swelling of the underlying courses, or by consolidation deep within the subgrade.

Recommended Repair: If the cause of the rutting is determined to be located in the AC surfacing,

If the cause of the rutting is below the AC surfacing, complete removal of the affected area and replacement of it with new material.

#### 5. Pavement Slippage

Slippage cracks are usually crescent shaped cracks resulting from horizontal forces induced by traffic. They are caused by a lack of bond between the surface layer and the course beneath. The lack of bonding may have occurred because of the presence of dust, dirt, oil, or even to the absence of a tack coat.

Recommended Repair: The cracked areas should be removed and patched. The proper way to repair a slippage crack is to remove the surface layer from around the crack to the point where there is good bond between the layers. Then patch the area with hot mix asphalt.

#### 6. Corrugations

Transverse undulations appear at regular intervals due to the unstable surface course caused by stop-and-go traffic. Corrugations are often associated with shoving and/or delamination. Note the size of the area.

Recommended Repair: If the AC surfacing is more than 2" thick, shallow corrugations can be removed by milling. The milled area then needs to be given a seal coat or a new AC surface.

In rural areas or if the AC surfacing is thicker than 2" and if the corrugated pavement has an aggregate base, the surface can be scarified (rubblelized), mixed with the existing, in-place aggregate base, and then recompact before placing an AC surfacing.

### III. Detailed Patching Procedures for Repairing a Distressed Location

#### A. Partial Depth Repairs (Surface Patches)

If the distress is judged to be only within the pavement surface, the base should remain in place and its integrity preserved. The area to be removed should extend at least a foot into the "good" pavement surrounding the distressed area and should be outlined on the pavement with paint. The existing AC pavement shall then be cold planed at the locations identified. Cold planing machines shall be equipped with a cutter head not less than 2.5 ft (750 mm) in width and shall be operated so as not to produce fumes or smoke. The outside lines of the planed area shall be neat and uniform. Planing asphalt concrete pavement operations shall be performed without damage to the surfacing that remains in place (see Standard Special Provision Number 15-660 or 15-670).

#### B. Full Depth Repairs ("Dig Outs")

The material in the area needs to be repaired and removed to a depth as deep as necessary to reach firm support (by definition typically a minimum of 4 inches). This may mean removing some of the subgrade. The excavation should also extend at least a foot into the "good" pavement surrounding the area to be patched. The area to be removed should be

outlined on the pavement with paint. A pavement saw shall be used to make neat rectangular cuts. The outlined area of the asphalt surfacing to be removed shall be saw cut to a depth of not less than 0.15 ft (45 mm) before removal.

The surface and base materials shall then be removed, as necessary, and shall be removed without damage to the materials that are to remain in place. The hole should be square edged. No loose material should remain. If the existing AC pavement surface is on an aggregate base, care must be taken to prevent the aggregate material from collapsing from under the edge of the remaining pavement. If the edge support is damaged, the pavement surrounding the patch may cause future failures.

After removing the AC surfacing and [chose one of the following scenarios]- -

- the underlying base is cement treated base in “good” condition [no visible cracking], the base should remain in place and its integrity preserved (no additional compaction is required).
- the underlying base is an unbound aggregate in “good” condition [no signs of deformation or evidence of migration of the fine materials or when probing with a soil’s probe - - a 3/8-inch metal conical-shaped pointed rod - - the rod should not penetrate firm material by more than 0.10 foot], the base should remain in place and its integrity preserved.
- the base material(s) is in need of removal [there are signs of deformation or evidence of migration of the fine materials or when probing with a soil’s probe - - a 3/8-inch metal conical-shaped pointed rod - - the rod penetrates the base material by more than 0.20 feet], the base material(s) is to be removed down to firm compacted material. A depth of 0.25 feet should then be removed and the remaining material investigated again to see if it is firm/compacted through the use of the soil’s probe. Continue to probe and examine the base, subbase and native material in 0.25 feet depth intervals until firm/compacted material is reached. Once the depth of removal has been determined, the material remaining in place shall be graded to a plane, moisture added, and compacted. Any locations where the base material is low, as a result of over excavation, shall be filled at the time of paving with asphalt concrete.

Next, the bottom and sides of the cut sections shall be primed using either liquid or emulsified asphalt. If the “dig out” is more than six inches deep, the backfill should be placed in layers (aggregate base and AC) and each layer compacted thoroughly [As an alternative, primarily because of constructibility reasons, the “dig out” can be backfilled with a dense graded hot asphalt plant mix.]. A vibratory plate compactor is excellent for small patches. A roller may be more practical for large areas. The repair is complete when the AC surface layer is placed and compacted flush with the surrounding pavement surface. Traffic must not be allowed on a patch repaired with only granular base material.

#### **IV. “Dig Outs” on Capital Preventive Maintenance (CapM) and Rehabilitation Projects**

##### **A. Capital Preventive Maintenance (CapM) Projects**

Dig outs, patching, and crack sealing of existing pavement prior to placement of CapM AC overlays should not exceed 20% of the project’s cost. The Region/District pavement managers have been instructed to accomplish any of these types of repairs using Maintenance resources, including State forces, to adhere to this limit.

## **B. Rehabilitation Projects**

As instructed for CapM projects, the Region/District pavement managers have been told to continue use “dig outs”, patching, and crack sealing repairs to the existing pavement using Maintenance resources until the pavement rehabilitation project is awarded. This guidance has been given in an attempt to limit the amount of these types of repairs required during the rehabilitation project.

Generally, the existing AC surfacing at severely failed localized areas (loose or spalled pavement) is removed and replaced with new AC prior to placing an AC overlay. If there is a base failure (generically indicated by rutting  $\geq 13$  mm), the base, as well as the AC may need to be removed and replaced with either a full-depth AC structural section or a structural section consisting of a combination of AC and base material prior to placing an AC overlay.

When the distress is more regional than localized, a thicker asphalt concrete overlay may be more cost effective than the expense of dig-out repairs. If, particularly in rural areas, the AC surfacing is thicker than 2” and AC pavement has an aggregate base, the surface can be scarified (rubblelized), mixed with the existing, in-place aggregate base, and then recompact before placing an AC surfacing.