Advisory Circular
[AC/AD – 003]

AERODROME PAVEMENTS MAINTENANCE PROCEDURES

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Forward

This Advisory Circular (AC) provides information on the types of pavement distress that occur and recommends corrective actions to undertake during preventive and corrective maintenance. This AC employs the visual distress identification and rating system known as the Pavement Condition Index (PCI) or Pavement Surface Evaluation and Rating (PASER) system. The AC also contains different types of pavement repair or maintenance methods that can be applied to restore pavement serviceability condition as appropriate.

The major objective in the design and construction of these pavements is to provide adequate load-carrying capacity and good ride quality necessary for the safe operation of aircraft under all weather conditions. Immediately after completion, aerodrome pavements begin a gradual deterioration that is attributable to several factors. Traffic loads in excess of those forecast during pavement design can shorten pavement life considerably.

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1.0 PAVEMENTS: COMPOSITION AND FUNCTION.

1.1 Introduction to Aerodrome Pavements

Aerodrome pavements are designed, constructed, and maintained to support the critical loads imposed by aircraft and to produce a smooth, skid-resistant, and safe-riding surface. The pavement must be of such quality and thickness to ensure it will not fail under the loads imposed and be durable enough to withstand the abrasive action of traffic, adverse weather conditions, and other deteriorating influences.

1.2 Classification Of Aerodrome Pavements

Generally, pavements fall into two classes: rigid and flexible pavements. Combinations of different pavement types and stabilized layers form complex pavements that can be classified as variations of the normal rigid and flexible types. Overlay pavements—existing pavement structures that are overlaid by either of the pavement types—are also common.

1.3 Rigid Pavement Composition and Structure

Rigid pavements normally use Portland cement concrete (PCC) as the prime structural element. Depending on conditions, engineers may design the PCC pavement slab with plain, lightly reinforced, continuously reinforced, pre-stressed, or fibrous concrete. The PCC pavement slab usually lies on a compacted granular or treated sub-base, which is supported, in turn, by a compacted sub-grade. The sub-base provides uniform stable support and may provide subsurface drainage. The PCC pavement slab has considerable flexural strength and spreads the applied loads over a large area.

1.4 Flexible Pavement Composition and Structure.

Flexible pavements support loads through bearing rather than flexural action as the rigid pavements. They comprise several layers of carefully selected materials designed to gradually distribute loads from the bituminous pavement (or hot mix asphalt –HMA) surface to the layers underneath. The design ensures the load transmitted to each successive layer does not exceed the layer's load-bearing capacity.

1.5 Aerodrome Pavement Overlays.

Aerodrome pavement overlays may correct deteriorating pavement surfaces, improve ride quality or surface drainage, maintain structural integrity, or increase pavement strength. Overlays are used when a pavement is damaged by overloading, requires strengthening to serve heavier aircraft, shows severe ponding because of uneven settling, or has simply served its design life and is worn out. Aerodrome pavement overlays generally consist of either PCC or bituminous pavements, or the resulting pavement system may be classified as either rigid or flexible for load support purposes.

2.0 PAVEMENT DISTRESSES

2.1 General

Various external signs or indicators make the deterioration of a pavement apparent, and often reveal the probable causes of the failure. This chapter provides a detailed discussion and description of the types of pavement distress and relates them to likely causal factors.

2.2 Types of Pavement Distress.

The discussions of problems related to pavement distress are generally based on whether the pavement has a rigid or flexible surface type. However, while different distresses possess their own particular characteristics, the various types generally fall into one of the following broad categories:

a. Cracking

b. Joint Seal Damage

c. Disintegration

d. Distortion

e. Loss of skid resistance

2.3 Modes of Rigid Pavement Distresses.

a. Cracking.

Cracks in rigid pavements often result from stresses caused by expansion and contraction or warping of the pavement. Overloading, loss of subgrade support, and insufficient and/or improperly cut joints acting singly or in combination are also possible causes. Several different types of cracking can occur such as:

- Longitudinal, Transverse, and Diagonal Cracks
- Corner Breaks
- Durability "D" Cracking
- Shrinkage Cracking
- Joint Seal Damage.

b. Disintegration.

Disintegration is the breaking up of a pavement into small, loose particles and includes the dislodging of aggregate particles. Improper curing and finishing of the concrete, unsuitable aggregates and improper mixing of the concrete can cause this distress. Disintegration falls into several categories:

- Scaling
- Spalling
- Blowups
- Pop-outs
- Patching.

c. Distortion.

Distortion refers to a change in the pavement surface's original position, and it results from foundation settlement, expansive soils or loss of fines through improperly designed sub-drains or drainage systems. Two types of distortion generally occur:

- Pumping
- Settlement or Faulting.

d. Loss of Skid Resistance.

Skid resistance refers to the ability of a pavement to provide a surface with the desired friction characteristics under all weather conditions. It is a function of the surface texture. Loss of skid resistance is caused by the wearing down of the textured surface through normal wear and tear or the buildup of contaminants.

e. Polished Aggregates.

Some aggregates become polished quickly under traffic. Naturally polished aggregates create skid hazards if used in the pavement without crushing. Crushing the naturally polished aggregates creates rough angular faces that provide good skid resistance.

2.4 Modes of Flexible Pavement Distresses

a. Cracking.

Cracks in flexible pavements are caused by deflection of the surface over an unstable foundation, shrinkage of the surface, thermal expansion and contraction of the surface, poorly constructed lane joints, or reflection cracking. Five types of cracks commonly occur in these types of pavements:

- Longitudinal and Transverse Cracks.
- Block Cracking
- Reflection Cracking
- Alligator or Fatigue Cracking
- Slippage Cracks.

b. Disintegration.

Disintegration in a flexible pavement is caused by insufficient compaction of the surface, insufficient asphalt binder in the mix, loss of adhesion between the asphalt coating and aggregate particles, or severe overheating of the mix. The following are common types of disintegration:

- Raveling and Weathering
- Potholes
- Asphalt Stripping
- Jet Blast Erosion
- Patching and Utility Cut Patch.

c. Distortion.

Distortion in HMA pavements is caused by foundation settlement, insufficient compaction of the pavement courses, lack of stability in the bituminous mix, poor bond between the surface and the underlying layer of the pavement structure, and swelling subgrade soils. Four types of distortion commonly occur:

- Rutting
- Corrugation
- Shoving
- Depression
- Swelling.

d. Loss of Skid Resistance.

Factors that decrease the skid resistance of a pavement surface and can lead to hydroplaning include too much asphalt in the bituminous mix, too heavy a tack coat, poor aggregate subject to wear, and buildup of contaminants. In bituminous pavements, a loss of skid resistance may result from the following:

- Polished Aggregate
- Contaminants
- Bleeding
- Fuel/Oil Spillage.

2.5 Drainage Of Aerodrome Pavements

A proper drainage system is essential to preventive maintenance. Probably no other factor plays such an important role in determining the ability of a pavement to withstand the effects of weather and traffic. The drainage system collects and removes surface water runoff, removes excess underground water, lowers the water table, and protects all slopes from erosion. An inadequate drainage system can cause saturation of the sub-grade and sub-base, damage to slopes by erosion, and loss of the load-bearing capacity of the paved surfaces.

3.0 METHODS FOR INSPECTION OF PAVEMENTS

3.1 Introduction to Pavement Inspection

Adequate and timely maintenance is the greatest single means of controlling pavement deterioration. Many cases exist where inadequate maintenance characterized by the absence of a vigorously followed inspection program directly attributed to failures of aerodrome pavements and drainage features. The maintenance inspection can reveal at an early stage where a problem exists and thus provide enough warning and time to permit corrective action.

3.2 Inspection Procedures.

Maintenance is an ongoing process and a critical responsibility of aerodrome personnel. Truly effective maintenance programs require a series of scheduled, periodic inspections or surveys, conducted by experienced engineers, technicians, or maintenance personnel. These surveys must be controlled to ensure that each element or feature being inspected is thoroughly checked, potential problem areas are identified, and proper corrective measures are recommended.

a. Inspection Schedules.

The aerodrome is responsible for establishing a schedule for pavement inspections. Inspection schedules should ensure that all areas, particularly those that are not observed daily, are thoroughly checked.

b. Records on pavement distress condition.

The aerodrome should prepare and maintain complete records of all inspections and maintenance performed. These records should document the severity level of existing distress types, their locations, their probable causes, remedial actions, and results of follow up inspections and maintenance.

3.3 Friction Surveys of Pavement Surfaces.

Aerodromes should maintain runway pavements that provide surfaces with good friction characteristics under all weather conditions. Parameters that affect the skid resistance of wet pavement surfaces include the following:

- Texture depth
- Rubber deposits
- Paint marking
- Pavement abnormalities, such as rutting, raveling, and depression

Visual observations made during a pavement inspection are an inadequate predictor of skid resistance.

3.4 Non Destructive Testing.

In addition to collecting information from visual inspections of the pavement area and about runway history, aerodromes should consider collecting data from nondestructive testing. Such data are used to evaluate the pavement load-carrying capacity. Loads are applied to the pavement through loading plates or wheels, and the pavement deflection response is recorded. The stiffness or strength of the aerodrome pavement can be related to the magnitude of these deflections. Nondestructive testing involves a large number of readings, and a statistical average is used.

3.5 Drainage Surveys

The maintenance program shall take into account the importance of adequate drainage of surface and ground water because water is directly or partly responsible for many pavement failures and deterioration. The personnel making the inspection should look for distress signals that may indicate impending problems. These distress signals include the following among others:

• Ponding of water
• Soil buildup at pavement edge preventing
runoff • Eroded ditches and spill basins
• Broken or displaced inlet grates or manhole
covers • Clogged or silted inlet grates and
manhole covers • Blocked subsurface drainage
outlets • Broken or deformed pipes
• Backfill settlement over pipes

3.6 Pavement Management Systems

Aerodrome pavement management systems (APMS) shall be provided as one method of establishing an effective maintenance and repair system. An APMS is a systematic and consistent procedure for scheduling maintenance and rehabilitation based on maximizing benefits and optimizing use of available resources. An APMS not only evaluates the present condition of a pavement, but also can be used to forecast its future condition. By projecting the rate of deterioration, an APMS can facilitate a life-cycle cost analysis for various alternatives and help determine the comparative analysis of given maintenance alternatives.

3.7 Pavement Performance Monitoring

Aerodromes operator shall use the pavement condition survey to develop pavement performance data. Distress intensity recorded over time helps determine how the pavement is performing. The data are indispensable for long term pavement performance monitoring system for understanding causes and mechanism of pavement distress.

3.8 Pavement Maintenance Management Program

Any aerodrome requiring funds for a project to replace or reconstruct a pavement must have implemented a pavement maintenance program.

4.0 SURFACE FRICTION TESTING AND MININUM FRICTION LEVEL

4.1 Friction Measuring Device

Continuous friction measuring device shall be used for measuring runway surface friction.

4.2 Determination of Minimum friction level

4.2.1 Runway surface friction characteristics need to be measured under the following circumstances:

a) the dry runway case, where only infrequent measurements may be needed in order to assess surface texture, wear and restoration requirements;

b) the wet runway case, where only periodical measurements of the runway surface friction characteristics are required to determine that they are above a maintenance planning level and/or minimum acceptable level. In this context, it is to be noted that serious reduction of friction coefficient from contamination of the runway, when wet, by rubber deposits;

c) the presence of a significant depth of water on the runway, and

d. when first constructed or after resurfacing to determine the wet runway surface friction characteristics.

4.2.2. The results of measurements will be used as follows:

a) to verify the friction characteristics of new or resurfaced sealed, asphalt or concrete surfaced runways, using the Design objective for new surface values below in the Table-1.

b) if the measured friction level falls below the relevant Maintenance planning level values in Table -1, the aerodrome operator must initiate appropriate corrective maintenance action to improve the friction.

c) if the measured friction level falls below the relevant Minimum friction level values in Table -1, the aerodrome operator must promulgate by NOTAM, that the runway pavement falls below minimum friction level when wet. Additionally, corrective maintenance action must be taken without delay. This requirement applies when friction characteristics for either the entire runway or a portion thereof are below the minimum friction level

Table -1: Friction Values for Continuous Friction Measuring Devices

Test Equipment	Test Tyre Pressure (kPa)	Test Speed (km/h)	Test Dept (mm)	Design Objective For New Surface	Maintenance Planning Level	Minimum Friction Level
Surface friction tester Trailer/vehicle	B 210 B 210	65 95	1.0 1.0	0.82 0.74	0.60 0.47	0.50 0.34
Runway friction tester Vehicle	B 210 B 210	65 95	1.0 1.0	0.82 0.74	0.60 0.54	0.50 0.41

4.3 Friction Survey Frequency

4.3.1 Friction measurements must be taken at intervals that will ensure identification of runways in need of maintenance or special surface treatment before the surface conditions deteriorate further. The time interval between measurements will depend on factors such as aircraft type and frequency of usage, climatic conditions, pavement type, and maintenance requirements.

Number of Daily Minimum Turbojet Aircraft Landings Per Runway End	Minimum Friction Survey Frequency
Less Than 15	1 Year
16 To 30	6 Months
31 To 90	3 Months
91 To 150	1 Months
151 To 210	2 Weeks
Greater Than 210	1 Week

4.3.2. The surface of a runway should be so constructed as to provide good friction characteristics for aeroplanes using the facility when the surface is wet. The surface of a bitumen seal, asphalt or concrete runway must not have irregularities that would result in the loss of frictional characteristics or otherwise adversely affect the take-off or landing of an aircraft. If a runway surface cannot meet the standards of paragraph 7.2.2, a surface treatment must be provided. Acceptable surface treatments include grooving, porous friction course and bituminous seals.

5.0 MATERIALS FOR MAINTENANCE WORKS

5.1 **General**

Normal day-to-day pavement maintenance will require hand tools, however some maintenance necessitates specialized equipment. Most normal maintenance projects require the following:

a. Mechanical Hammers.

b. Trailer-Type Asphalt Kettles.

c. Compaction Equipment.

d. Distributors.

e. Work Crew.

5.2 **Common Materials for Maintenance and Repair**.

The Aerodrome operator shall use the materials listed below for maintenance and repair of pavements.

a. Hot-Mix Asphalt.

HMA is a blend of asphalt binder and well-graded, high-quality aggregates. The materials are mixed in a plant and placed and compacted while hot. HMA is used for construction of new airfield pavement and patching and overlay of airfield pavements.

b. Tack Coat.

A tack coat, usually a light application of emulsified asphalt, is applied to an existing pavement to provide a bond with an overlying course, such as a HMA overlay. A tack coat is also used on the sides of an existing pavement that has been cut vertically before patching. Asphalt emulsions are manufactured in several grades and are selected by the desired setting time.

c. Prime Coat.

A prime coat of emulsified or cutback asphalt is applied to an aggregate base course for the following purposes:

(1) To waterproof the surface of the base

(2) To plug capillary voids

(3) To promote adhesion between the base and the surface

course d. **Fog Seal.**

A fog seal is a light application of emulsified asphalt used to rejuvenate the surface of a HMA pavement.

e. Aggregate Seal.

This process is used to seal the surface of weathered pavements. Aggregate seals consist of sprayed asphalts that are immediately covered with aggregate and rolled to seat the aggregate in the asphalt coating. Aggregate seals for airfield pavements are not recommended because of the potential for propeller and engine damage caused by loose aggregates.

f. Slurry Seal.

A slurry seal is a mixture of asphalt emulsion, fine aggregate, mineral filler, and water. The mixture is prepared in slurry form and applied in a film approximately 1/8 inch (3 mm) thick. Slurry seals are used to seal small cracks, correct surface conditions, and improve the skid resistance of pavement surfaces.

g. Coal-Tar Sealer.

Coal-tar sealer is a coal-tar-based product designed to coat the surface and protect the pavement against fuel spill damage and the intrusion of air and water. It is cold applied and should be periodically reapplied and maintained. Coal-tar sealers may contain fine aggregates to enhance traction and applied in multiple coatings.

h. Crack and Joint Sealants for Flexible Pavement

Material for sealing cracks should meet relevant ASTM standards for the type of pavement and service for which the pavement is intended.

i. Crack and Joint Sealing Material for Rigid Pavement.

Material for sealing joints in Portland cement concrete pavement may be hot- or cold-applied compounds, as long as they meet the following standards:

j. Crack Filler Material for Flexible or Rigid Pavement.

Material for filling cracks in rigid or flexible pavement should meet ASTM D 5078.

k. Concrete

Concrete is a blend of Portland cement, fine and coarse aggregate, and water, with or without additives. Concrete is used to repair a distressed Portland cement concrete pavement so it may be used at its original designed capacity.

l. Epoxy Grouts and Concretes.

There are many types of epoxy resins; the type to be used depends on the intended application. Under normal conditions, mixed resins may be workable up to 1 hour after mixing. Repairs with epoxy materials are costly, so their use should be limited to small areas and their application left to experienced personnel.

6.0 PAVEMENT REPAIR METHODOLOGIES

6.1 General

Repair method for a particular pavement type, whether rigid or flexible, is dependent on degree, mechanism of distresses and material characteristics. Different methods of repair are available to address the different distresses. However, in many cases pavements fails due to a combination of causative factors and therefore an aerodrome operator shall choose a repair method based on rational assessment of the prevailing condition.

6.2 Repair Methods for Rigid Pavements.

A. CRACK REPAIR AND SEALING

Sealing cracks prevents surface moisture from entering the pavement structure. This type of repair first requires establishing a properly shaped sealant reservoir, which should be done with a saw rather than with router equipment because routers use a mechanical impact to remove material and can cause micro-cracks in the concrete.

(1) Longitudinal, Transverse, and Diagonal Cracks. The procedures for repairing these types of cracks are as follows:

- Saw a groove to the width and depth recommended by the sealant manufacturer. The width needs to be sufficient to allow the material to stretch and contract with movement in the pavement. Common hot-pour materials typically require a width equal to the depth. Silicone materials typically require a width twice the dimension of the depth.
- Sand blast both sides of the sealant reservoir, and clean it out with compressed air. The groove must be dry and free of dirt, dust, and other material that might prevent bonding of the sealant.
- Place a bond breaker at the proper depth to establish the joint sealant reservoir. Bond breakers are necessary to prevent bonding of the sealant material to the bottom of the crack.
- Fill the joint reservoir with sealant, recessing the sealant approximately ¼ inches (6 mm) below the pavement surface. Excess sealant on the pavement surface does not assist in sealing the crack and is prone to tracking and damage from wheels and snow removal equipment.

(2) Corner Cracks. Structural distress requires full-depth repairs. Corner cracks (cracking of the panel between two adjacent joints), cracks more than ¾-inches (19 mm) wide with spalling, cracks more than 1-1/2-inches (38 mm) wide, and/or cracks associated with loss of subgrade support typically signify the presence of structural distress. The procedures for repairing these types of cracks are as follows:

i. Make full-depth saw cuts at constructed joints. Make the saw cuts so the repair area is rectangular when the repair is for wide cracks that transect a panel. For corner cracks, cut the repair area square.

ii. Use a jackhammer or tractor mounted hammer to remove material within the limits of the sawcuts. During the repair, try to minimize any disturbance to the subgrade soils or base materials.

iii. Restore subgrade or subbase materials to the base elevation of the panel being repaired.

iv. Use tie-bars consisting of #4 deformed bars (#5 bars for pavements more than 12-inches (30 cm) thick) in the faces of the parent panel. Install by drilling into the face and using an epoxy bonding agent. Use equidistant spacing of the bars, but do not install them more than 24-inches (60 cm) apart.

v. Use dowel bars in the joint that parallels the direction of traffic. On aprons and areas where traffic may be oblique to joints, install dowels in both joint faces. Dowels are installed by drilling and spaced at least one bar spacing away from faces parallel to the dowel bar.

vi. Install nonabsorbent board within the limits of the joint seal reservoirs along the adjacent concrete panels. When repairing multiple panels, restore the joint seal reservoirs with the nonabsorbent filler board.

vii. Backfill the repair area with concrete, being sure to consolidate the concrete along the limits of repair. Exercise caution when working adjacent to existing concrete faces during consolidation, and watch for segregation of the concrete.

viii. After the concrete cures, remove the filler board by sawing. Reinstall joint seal material.

(3) "D" Cracking. This type of distress usually requires repairing the complete slab since "D" cracking will normally reappear adjacent to the repaired areas.

(4) Joint Seal Damage. The sequence of operations for preparing joints for resealing is as follows:

i. Use a joint plow or diamond saw blade to remove the joint sealing material to the full depth of the reservoir for contraction and construction joints. As a minimum, remove the joint sealant material to a depth sufficient to establish a proper shape factor for the new sealant material.

ii. When changing the material type of the joint seal, re-facing is recommended. Re-facing will result in a change to the reservoir shape factor (width to depth ratio). Remove any remaining debris by sand blasting each face of the joint reservoir.

iii. If the same material will be used to replace the existing joint seal, clean the reservoir with high-pressure water or sand blasting.

iv. Immediately prior to sealing, blow out the joint with clean, oil-free compressed air to remove sand, dirt, and dust.

v. Install new dry backer rod.

vi. Seal joints with hot or cold compounds.

B. DISINTEGRATION

If not impeded in its early stages, disintegration can progress rapidly until the pavement requires complete rebuilding.

(1) Scaling, Map Cracking, and Crazing. This distress is often noticeable with little or no surface deterioration. Severe cases of scaling, map cracking, or crazing can produce considerable FOD, which can damage propellers and jet engines. If the distress is severe and produces FOD, the repair method is to remove the immediate surface and provide a thin bonded overlay. The procedures for repairing these types of distress are as follows:

i. Make a vertical cut with a concrete saw 2 inches (5 cm) in depth and approximately 2 inches (5cm) back of the affected area.

ii. Remove all unsound concrete until sound, intact material has been reached. Remove the unsound concrete with air hammers, pneumatic drills, shot blasters, or grinding equipment, and blow out the area with compressed air.

iii. Clean the area to be repaired with high-pressure water. Allow the patch area to dry completely if required by the patch material specification.

iv. Treat the surface with a grout mixture to ensure a good bond between the existing pavement and the new concrete. Apply the grout immediately before placing the patch mixture and spread with a stiff broom or brush to a depth of 1/16 inch (2 mm).

v. If the repair crosses or abuts a working joint, place a thin strip of wood or metal coated with bond-breaking material in the joint groove, and tamp the new mixture into the old surface.

vi. After edging the patch, finish it to a texture matching the adjacent area.

vii. After a proper cure period, fill any open joints with joint sealant prior to opening to traffic.

(2) Joint Spalling and Corner Spalling. The procedure for the repair of spalls is as follows:

i. Make a vertical cut with a concrete saw 2 inches (5 cm) in depth and approximately 2 inches (5 cm) back of the spalled area.

ii. Remove all unsound concrete until sound, intact material has been reached. Break out the unsound concrete with air hammers or pneumatic drills and blow out the area with compressed air.

iii. Clean the area to be repaired with high-pressure water. Allow patch area to dry completely if required by the patch material specification.

iv. Treat the surface with a grout mixture to ensure a good bond between the existing pavement and the new concrete. Apply the grout immediately before placing the patch mixture and spread with a stiff broom or brush to a depth of 1/16 inch (2 mm).

v. Place a thin strip of wood or metal coated with bond-breaking material in the joint groove and tamp the new mixture into the old surface. The mix should be air-entrained and designed to produce a no slump concrete, which will require tamping to place in the patch.

vi. After edging the patch, finish it to a texture matching the adjacent area.

vii. After a proper cure period, fill the open joint with joint sealant prior to opening to traffic.

(3) Blowups. Blowups may be repaired using the following procedures:

i. Make a full-depth vertical cut with a concrete saw approximately 6 inches (15 cm) outside of each end of the broken area.

ii. Break out the concrete with pneumatic tools, and remove concrete down to the subbase/subgrade material.

iii. Add subbase material, if necessary, and compact.

iv. In reinforced pavement construction, use joint techniques to tie the new concrete to the old reinforced material. Dowel any replacement joints, and build them to joint specifications.

v. Dampen the subgrade and the edges of the old grout.

vi. Place concrete on the area to be patched. Ready-mixed concrete may be used if it is satisfactory and can be obtained economically. Consider using a mixture providing high early strength in order to permit the earliest possible use.

vii. Finish the concrete so the surface texture approximates that of the existing pavement.

viii. Immediately after completing finishing operations, properly cure the surface with either a moist cure or a curing compound.

(4) Shattered Slab. A shattered slab requires replacing the full slab. Follow the same procedures used for blowup repairs except remove unstable subgrade materials and replace with select material. Correct poor drainage conditions by installing drains for removal of excess water.

C. DISTORTION

If not too extensive, some forms of distortion, such as that caused by settlement, can be remedied by raising the slab to the original grade. Slabjacking procedures may be used to correct this type of distress. In slabjacking, a grout is pumped under pressure through holes cored in the pavement into the void under the pavement. This creates an upward pressure on the bottom of the slab in the area around the void. The upward pressure lessens as the distance from the grout hole increases. Thus, it is possible to raise one corner of a slab without raising the entire slab. Because of the special equipment and experience required, slabjacking is usually best performed by specialty contractors.

D. LOSS OF SKID RESISTANCE

Rehabilitation treatment includes resurfacing, milling, diamond grinding, shot peening, and surface cleaning. Grooving may be considered when a loss of skid resistance is observed. Grooving does not impact the surface texture but does provide a channel for water that becomes trapped between a pavement and the tire to escape. Grooving thus minimizes the potential for hydroplaning during wet conditions.

(1) Polished Aggregate. Since polished aggregate distress normally occurs over an extensive area, consider milling or diamond grinding the entire pavement surface. Concrete or bituminous resurfacing may also be used to correct this condition.

(2) Contaminants. Remove rubber deposits with high-pressure water or biodegradable chemicals.

6.3 Repair Methods for Bituminous Concrete Pavements

A. CRACK SEALING

Cracking takes many forms. In some cases, simple crack filling may be the proper corrective action. Some cracks, however, require complete removal of the cracked area and the installation of drainage.

(1) Longitudinal, Transverse, Reflection, and Block Cracking. In areas where narrow cracks are present, a seal coat, slurry seal, or fog coat may be applied. Narrow cracks can also be widened by sawing or routing. Wide cracks, greater than 1/4 inch (6mm), should be sealed using the following procedure:

i. Clean out the crack with compressed air to remove all loose particles. If necessary, rout to widen the crack prior to utilizing compressed air. Also, address any required weed prevention.

ii. Fill cracks with a prepared crack sealer.

(2) Alligator Cracking. Permanent repairs by patching may be carried out as follows:

i. Remove the surface and base as deep as necessary to reach a firm foundation. In some cases, a portion of the subgrade may also have to be removed. Use a power saw to make vertical square or rectangular cuts through the pavement.

ii. Replace base material with material equal to that removed, but if the base material has proved problematic, replace it with a more appropriate material.Compact each layer placed.

iii. Apply a tack coat to the vertical faces of the existing pavement.

iv. Place bituminous concrete and compact.

v. If necessary, saw and seal the joints around the perimeter of the patch area.

(3) Slippage Cracks. One repair method commonly used for slippage cracks involves removing the affected area and patching with plant-mixed asphalt material. Specific steps are given below:

i. Remove the affected area and at least 1 foot (30 cm) into the surrounding pavement. Make the cut faces straight and vertical. A power pavement saw makes a fast and neat cut.

ii. Clean the surface of the exposed underlying layer with brooms and compressed air.

iii. Apply a light tack coat.

iv. Place sufficient hot plant-mixed asphalt material in the cutout area to make the compacted surface the same grade as that of the surrounding pavement.

v. Compact the asphalt mixture with steel-wheel or rubber-tire rollers until the surface is the same elevation as the surrounding pavement.

B. DISINTEGRATION

If not impeded in its early stages, disintegration can progress rapidly until the pavement requires complete rebuilding. Sealer-rejuvenator products can be applied to retard disintegration. The products help reverse the aging process of the surface asphalt. Deterioration from raveling may also be impeded by applying a light fog seal or a slurry seal. The basic procedures for either surface treatment are as follows:

i. Sweep the surface free of all dirt and loose aggregate material

ii. Apply the surface treatment

iii. Close to traffic until the seal has cured

C. DISTORTION

Repair techniques for distortion range from leveling the surface by filling with new material to completely removing of the affected area and replacing with new material. Cold milling can be employed prior to overlaying for many of these distresses.

(1) Rutting. The repair procedures are as follows:

i. Determine the severity of the rutting with a straightedge or stringline. Outline the areas to be corrected on the pavement surface

ii. Mill or grind down the identified area to provide a vertical face around the edge.

iii. Thoroughly clean the entire area.

iv. Apply a light tack coat of asphalt emulsion to the area to receive asphalt material, including the vertical face of the patch area.

v. Spread enough dense-graded asphalt concrete in the prepared area to bring it to the original grade when compacted. Deeper patches may require multiply lifts to allow proper compaction of each lift.

vi. Thoroughly compact the asphalt patch material with a roller or vibratory plate compactor.

(2) Corrugation and Shoving. The repair procedure for this type of distress is the same as for patch repair of alligator cracking.

(3) Depressions. The repair procedures are as follows:

i. Determine the limits of the depression with a straightedge or stringline. Outline the depression on the pavement surface.

ii. Mill or grind down the area to provide a vertical face around the edge.

iii. Thoroughly clean the entire area to be repaired.

iv. Apply a light tack coat of asphalt emulsion to the area to receive asphalt material, including the vertical face of the patch area.

v. Spread enough bituminous concrete in the depression to bring it to the original grade when compacted. Deeper patches may require multiply lifts to allow proper compaction of each lift.

vi. If the pavement was not ground down, feather the edges of the patch by careful raking and manipulation of the material. However, in raking, take care to avoid segregation of the coarse and fine particles of the mixture. With additional effort, a more suitable and longer-lasting patch can result by vertically grinding the edges down or sawing and using a light jackhammer to create a vertical edge with no feathering and little raking required.

vii. Thoroughly compact the patch with a roller or vibratory-plate compactor.

D. SWELLING

The repair procedure is the same as for patch repair of alligator cracking.

E. LOSS OF SKID RESISTANCE

Treatment for loss of skid resistance includes removal of excess asphalt, resurfacing, grooving to improve surface drainage, and removing of rubber deposits.

(1) Bleeding. A pavement milling or grinding machine may be used to remove the excess asphalt by milling off 1/8 inch to 1/4 inch (3 to 6 mm) of pavement. Repair procedures using hot sand or aggregate are as follows:

i. Apply slag screenings, sand, or rock screenings to the affected area. Heat the aggregate to at least 300º F (150º C) and spread at the rate of 10 to 15 pounds per square yard (4 to 9 kg per m2).

ii. Immediately after spreading, roll with a rubber-tired roller.

iii. When the aggregate has cooled, broom off loose particles.

iv. Repeat the process if necessary.

(2) Polished Aggregate. One means of correcting this condition is to cover the surface with an aggregate seal coat. Grooving, milling, or diamond grindings the pavement surface are also useful techniques.

(3) Fuel Spillage. Permanent repairs for areas subjected to continuous fuel spillage consist of removal of the damaged pavement and replacement with Portland cement concrete or bituminous asphalt, and application of a coal-tar emulsion seal coat or other fuel-resistant coating.

(4) Contaminants. Rubber deposits may be removed by use of high-pressure water or biodegradable chemicals.

2.0 REFERENCES

2.1 Bhutan Aerodrome Standards (BAS)

2.2 ICAO Doc 9157 –Part 3 (Pavements)

2.3 ICAO Doc 9137 – Part 9 (Aerodrome Maintenance Practices)

2.4 ICAO Doc 9137 – Part 2 (Pavement Surface Conditions)

2.5 ICAO Annex 14 – Volume 1 (Aerodrome Design & Operations)

2.6 FAA AC 150/5380-6B – Guidelines and Procedures for Maintenance of Airport Pavements

2.7 FAA AC 150/5320-17 Pavement Surface Evaluation and Rating (PASER) system

2.8 American Standards for Testing Materials (ASTM)