Florida Department of Transportation

AVIATION OFFICE

AIRFIELD PAVEMENT DISTRESS REPAIR MANUAL

2013

FDOT STATEWIDE AIRFIELD PAVEMENT MANAGEMENT PROGRAM

Use of Manual

This Airfield Distress Repair Manual has been updated with the latest information from the FAA and the ASTM 150/5380-6A. Additional distress pictures were added for clarity and easy recognition for maintenance repair performers while on the field. This PMP Airfield Pavement Inspection Manual has been developed by the Florida Department of Transportation Central Aviation Office.

Examples of various pavement distress types identified in this airfield distress repair manual are presented by name in order to assist airfield maintenance repair performers. The various illustrations, charts and supporting information descriptions are presented to aid in the identification, severity, location, extent, and probable causes of pavement distresses for both flexible and rigid pavement types.

The majority of the photographs of various pavement conditions were collected and assembled specifically for the development of this Airfield Pavement Inspection Manual. A limited number of photographs are also presented and referenced that were developed by the sources listed in the References section of this manual

Disclaimer:

THIS MANUAL HAS BEEN APPROVED BY THE FLORIDA DEPARTMENT OF TRANSPORTATION AND IS BASED ON INFORMATION FROM VARIOUS SOURCES. WHILE REASONABLE CARE HAS BEEN TAKEN IN PREPARING THIS DOCUMENT, NO RESPONSIBILITY OR LIABILITY IS ACCEPTED FOR ERRORS OR FACTS OR FOR ANY OPINION EXPRESSED HEREIN.

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CLASSIFICATION OF AIRFIELD PAVEMENTS

Flexible Pavements

- Asphalt cement and aggregates
- Strength affected by temperature
- Relatively easy to repair
- Composed of 5 layers: HMA Surface/Base course/Sub-base (*)/Frost Protection (*) & Sub-grade

Rigid Pavements

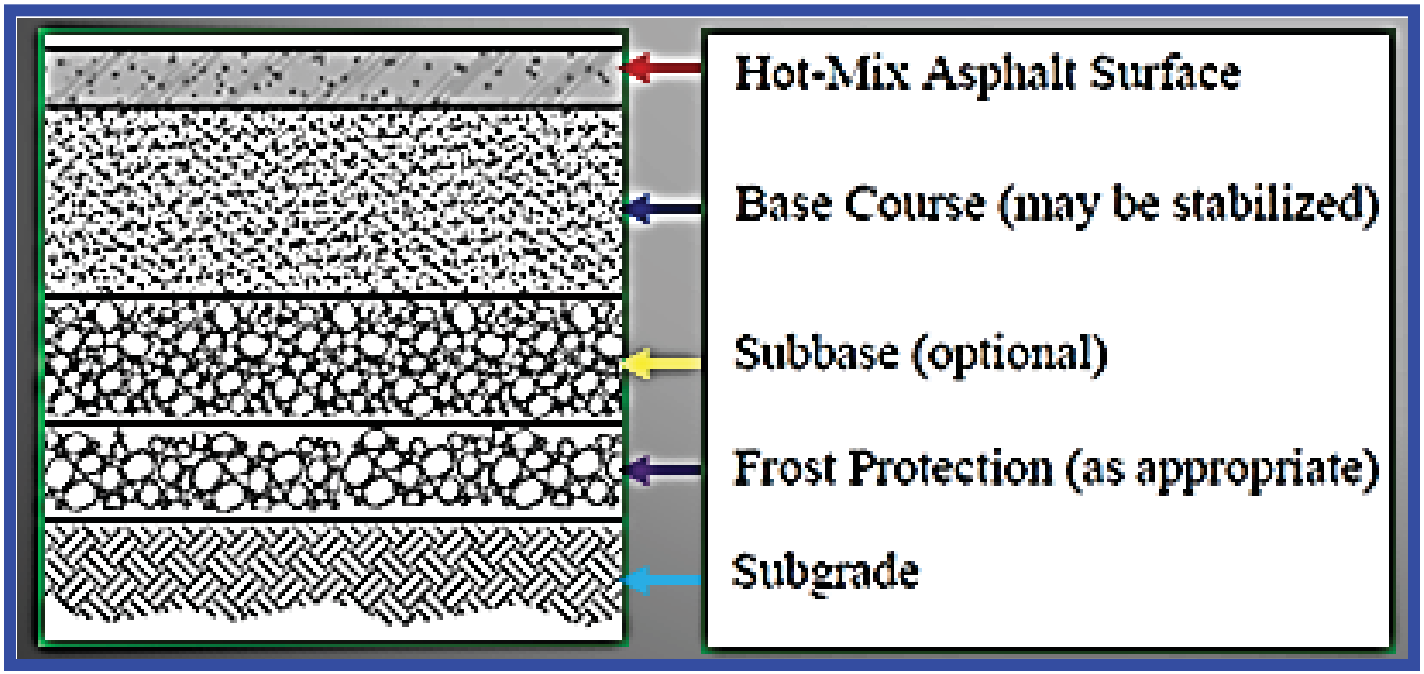
- Portland cement and aggregates
- Very strong, durable
- Expensive to repair
- Composed of 4 layers: PCC Slab/ Sub-base / Stabilized Sub-base(**)/Frost Protection(*) & Sub-grade.

Composite Pavements

- Asphalt over Concrete

(*) As needed, (**) May be stabilized if accommodating $\geq$ 100,000lbs

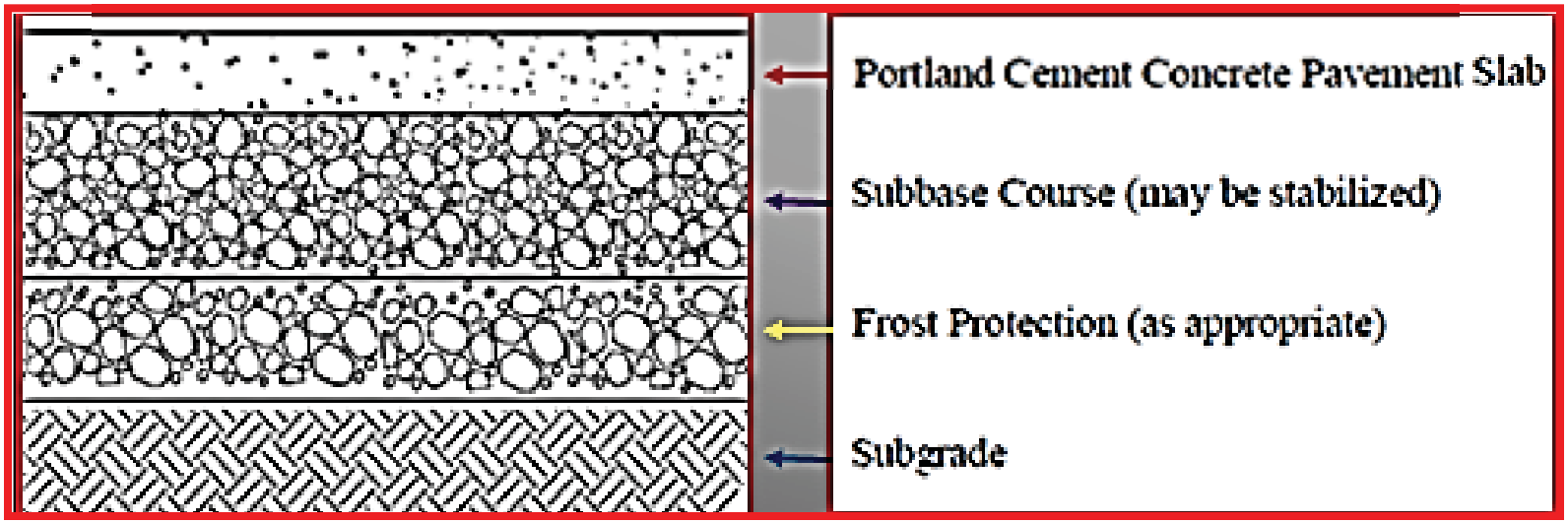
FLEXIBLE PAVEMENT
COMPOSITION & STRUCTURE



- Asphalt cement and aggregates
- Strength affected by temperature
- Relatively easy to repair
- Composed of 5 layers: HMA Surface/Base course/Sub-base **(*)** Frost Protection **(*)** & Subgrade

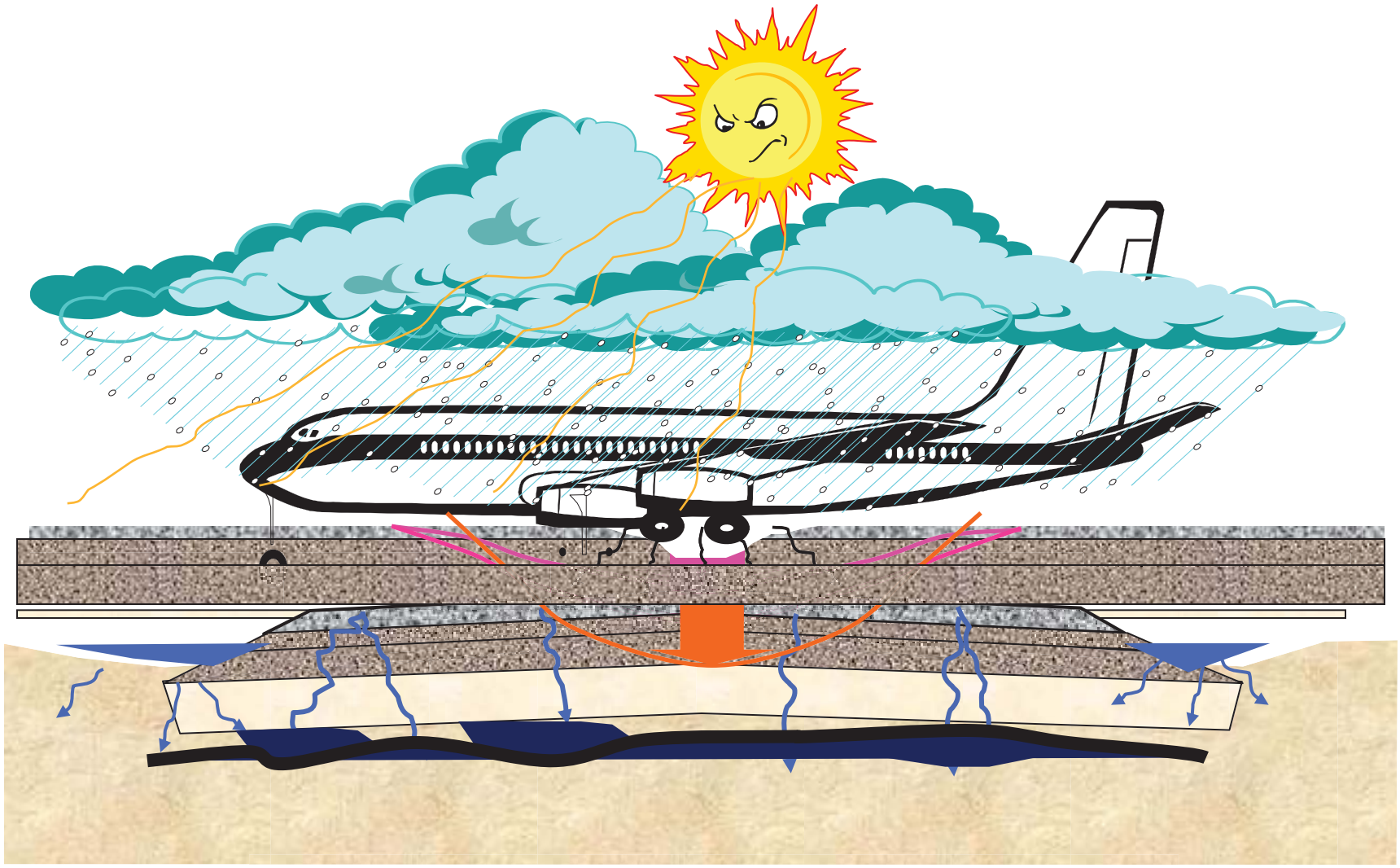
(*) = As needed

RIGID PAVEMENT
COMPOSITION & STRUCTURE



- Portland cement and aggregates
- Very strong, durable
- Expensive to repair
- Composed of 4 layers: PCC Slab/ Sub-base / Stabilized Sub-base **(**)**/Frost Protection**(*)** & Subgrade

(*), (**) = As needed



CAUSES OF FAILURE

CAUSES OF FAILURE

Environment: (Non-Load, including drainage and environmental effects)

- Swell
- Blowups

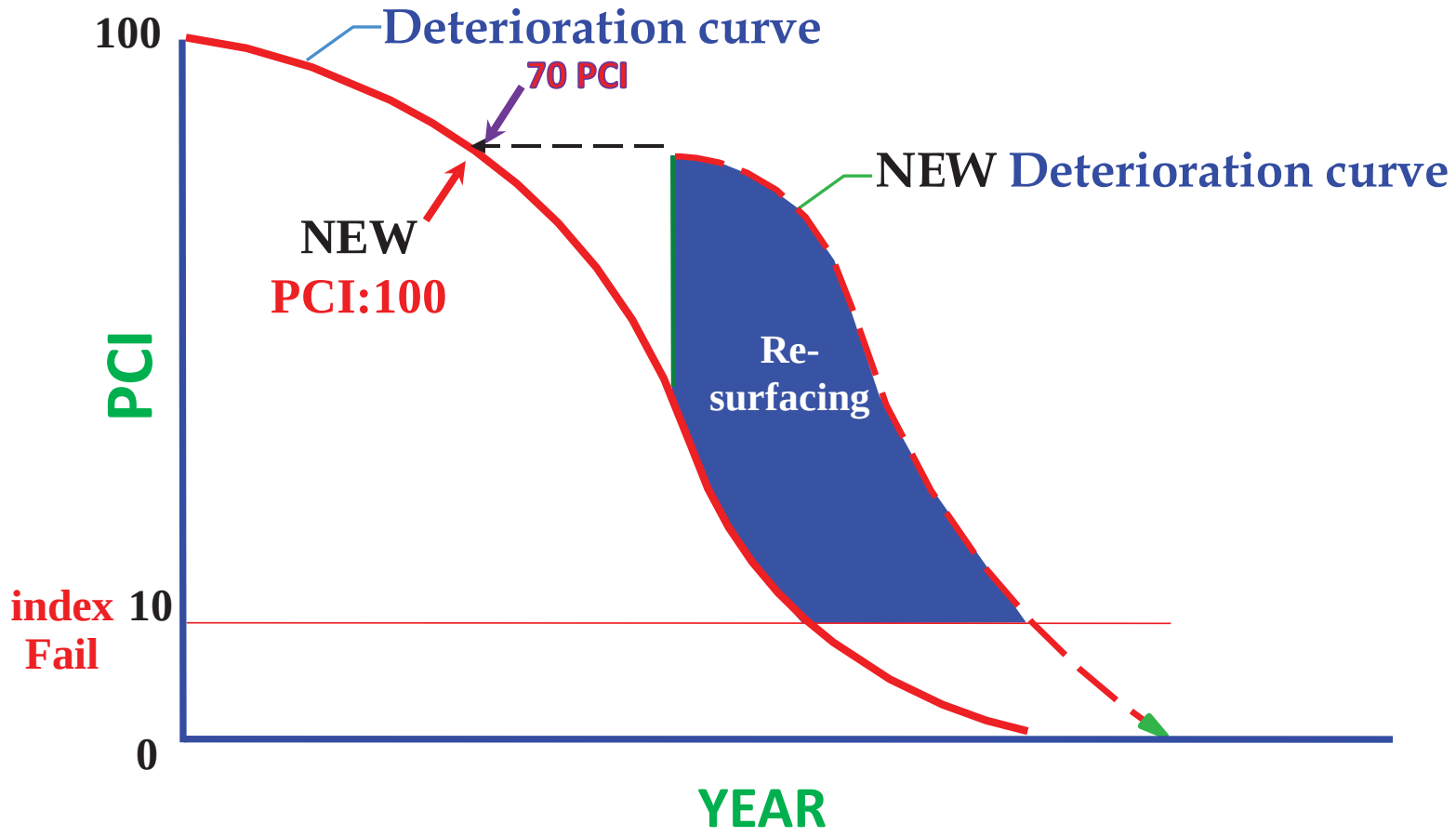
Load : (too much traffic or weak structure (or both):

- Alligator cracks
- Corner breaks
- Joint spalls

Construction/materials related:

- Bleeding
- Crazing/map cracking

RENEW THE LIFE OF PAVEMENT



Pavement deterioration is inescapable fact. When you renew the pavement, you actually extend its life.

AIRFIELD PAVEMENT DISTRESS (AC & PCC)

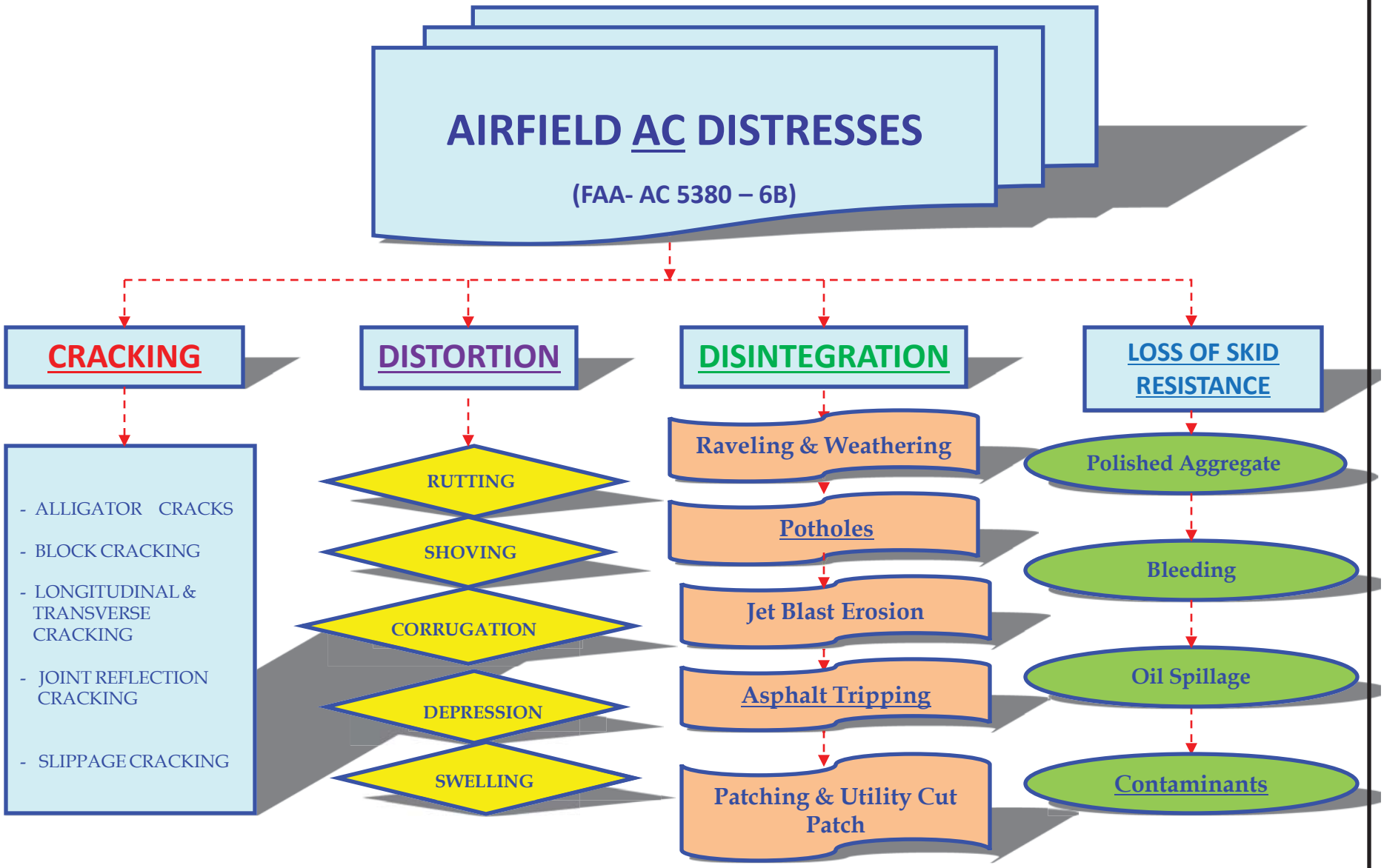
- CRACKING
- JOINT SEAL DAMAGE
- DISINTEGRATION
- DISTORTION
- LOSS OF SKID RESISTANCE

AIRFIELD PAVEMENT DISTRESS

(AC & PCC)

DISTRESS TYPE:	AC	PCC
CRACKING	- Longitudinal, Transverse Cracks - Block Cracking, - Reflection Crack - Alligator Crack - Slippage Crack	- Longitudinal, Transverse, and Diagonal Crack - Corner Breaks - Durability "D" Cracking - Shrinkage Cracking
JOINT SEAL DAMAGE	N/A	- Joint Seal Damage
DISINTEGRATION	- Raveling and Weathering - Potholes - Asphalt Stripping - Jet Blast Erosion - Patching & Utility Cut Patch	- Scaling, Map Cracking, and Crazing, - Joint Spalling - Corner Spalling - Shattered Slab/Intersecting Cracks - Blowups - Pop-outs - Patching: Small, Large and Utility
DISTORTION	- Rutting - Corrugation -Shoving -Depression - Swelling.	- Pumping - Settlement or Faulting
LOSS OF SKID RESISTANCE	- Polished Aggregates - Contaminant - Bleeding - Fuel/Oil Spillage	- Polished Aggregates, - Contaminants

AC DISTRESS CATEGORIZATION



* Underlined distresses are recognized by the FAA but not by the ASTM

CRACKING

DEFINITION:

Break without completely separating. These distresses may include ALLIGATOR, BLOCK CRACKING, LT CRACKING, REFLECTION CRACKING, and SLIPPAGE CRACKING.

METHODS OF REPAIR:

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.

DISTORTION

DEFINITION:

Distortion is any change of the pavement surface from its original shape.
Distortions in an asphalt pavement are caused by instability of an asphalt mix or weakness of the base or sub-grade layers. These distresses may include RUTTING, SHOVING, DEPRESSIONS, SWELLING, and PATCH FAILURE.

METHODS OF REPAIR:

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

DISINTEGRATION

DEFINITION:

Disintegration is the breakup of a pavement into small pieces that are lost with time and traffic . RAVELING and POTHOLES are the most common types of **disintegration**.

METHODS OF REPAIR:

If not impeded in its early stages, disintegration can progress rapidly until the pavement requires complete rebuilding. Permanent repairs by patching may be carried out. 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.

SKIDDING HAZARDS

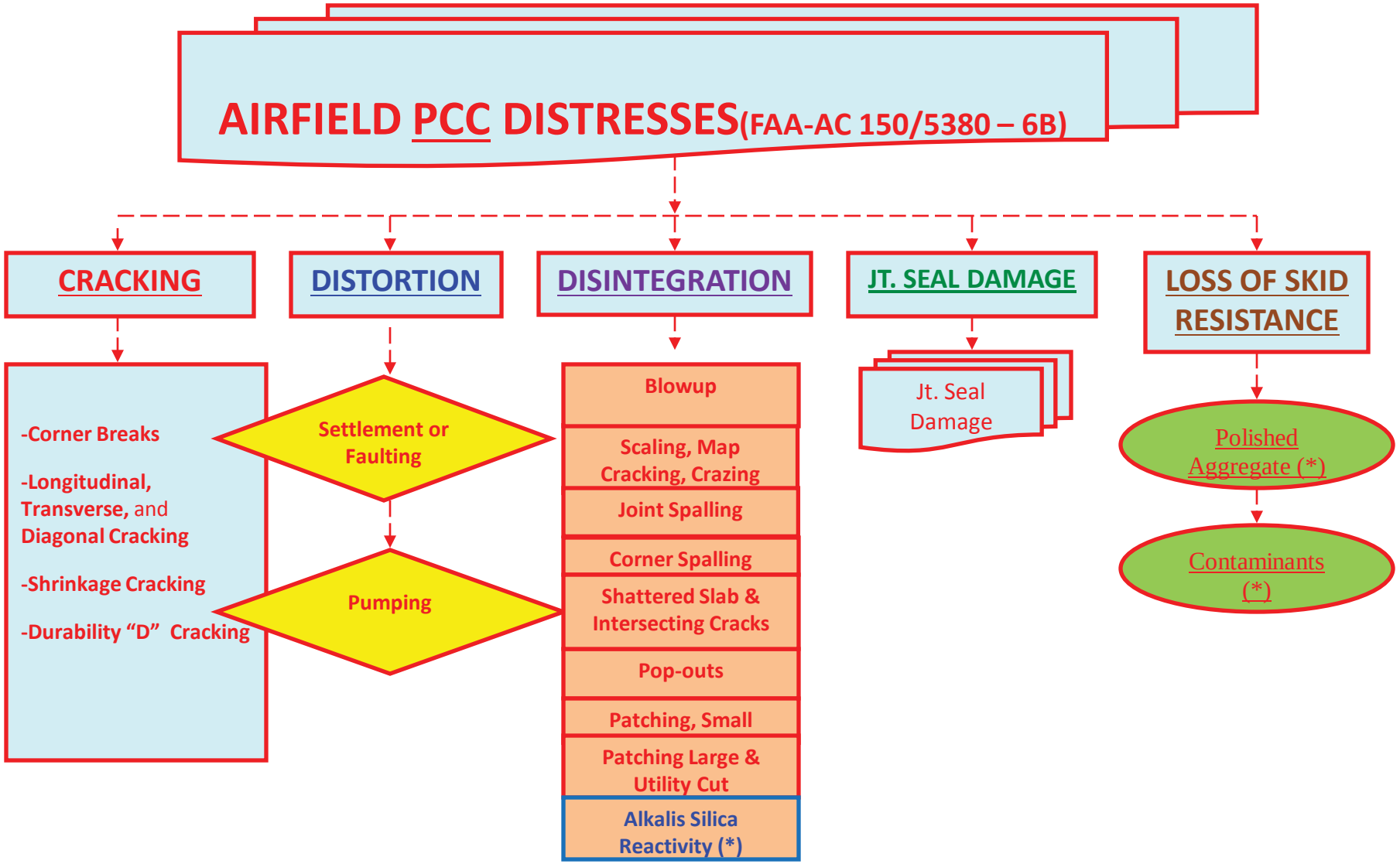
DEFINITION:

Skidding hazards are caused by water on the surface of the pavement, polished aggregates, or excess asphalt or other lubricants on the pavement' s surface.

METHODS OF REPAIR:

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

PCC DISTRESS CATEGORIZATION



(*) The ASTM does not separately discuss Alkali Silica Reactivity, Polished Aggregate, and Contaminants

CRACKING

DEFINITION:

Break without completely separating. These distresses may include LONGITUDINAL, TRANSVERSE & DIAGONAL CRACKS, CORNER BREAKS, DURABILITY “D” CRACKING, SHRINKAGE CRACKING.

METHODS OF REPAIR:

This type of repair first requires establishing a properly shaped sealant reservoir followed by application of an appropriate joint sealing compound and backer rod as appropriate. The reservoir should be cut with a saw rather than a router as routers us a mechanical impact to remove material and may cause micro-cracks in the concrete.

DISINTEGRATION

DEFINITION:

Disintegration is the breaking up of a pavement into small, loose fragments. This includes the dislodging of aggregate particle. If not stopped in its early stages, it can progress until the pavement requires complete rebuilding.

METHODS OF REPAIR:

The follow up repair procedure for this category depends on whether full-depth repair or partial depth repair is performed. (See full-depth or partial-depth repair for concrete on page 108 and 117)

DISTORTION

DEFINITION:

Distortion is any change of the pavement surface from its original shape, such as FAULTING, PUMPING etc.

METHODS OF REPAIR:

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. An option for repairing some types of settlement or faulting, which are not extensive in grade variation, is to micro-mill the pavement surface to true and level.

JOINT SEAL DAMAGE

DEFINITION:

The definition for Jt. Seal Damage is: "any condition that enables soil or rocks to accumulate in the joints or that allows infiltration of water."

METHODS OF REPAIR:

Remove old joint material and any foreign material in the joint and reseal the joint.

SKID HAZARD

DEFINITION:

A number of things can make a pavement slippery when wet. A major cause of slippery Portland cement concrete pavement is polished aggregate in the surface. The aggregate particles may be smooth, uncrushed gravel. Slipperiness also may develop from surface contamination.

METHODS OF REPAIR:

Rehabilitation treatment includes resurfacing, milling, diamond grinding, and surface cleaning. Grooving may be considered when a loss of skid resistance is observed. Grooving thus minimizes the potential for hydro- planing during wet conditions.

REPAIR SELECTION CATEGORIZATION

PERMANENT REPAIRS:

Permanent repairs are conducted on pavement areas that are in good condition in order to restore the life cycle of those that need to be repaired.

SEMI-PERMANENT REPAIRS:

Semi-permanent repairs have a typical life expectancy of one or two years. Usually, the area does not need to be saw cut, and may be repaired with cold mix.

TEMPORARY REPAIRS:

Temporary repairs are used to hold the pavement until it can be resurfaced or permanently repaired.

EMERGENCY REPAIRS:

Emergency repairs are applied when the pavement condition may become a hazard to airplane operations.

Legend for the repair section:

Recommendation: R
Permanent Repair: P
Temporary Repair: T
Emergency Repair: E
Semi-Permanent Repair: S/P

Legend for the distress severity levels:

Low Severity: L
Medium Severity: M
High Severity: H

FAA's REPAIR METHODOLOGIES

- MICRO - MILL
- DIAMOND GRINDING
- MICRO SURFACING
- ASPHALT LEVELING COURSE
- ASPHALT SURFACING TREATMENT
- RANDOM CRACKING SAW
- VERTICAL SPINDLE ROUTER
- SAND – BLASTING
- WATER - BLASTING

REHABILITATION

- **The selection of a specific rehabilitation method involves both economic and engineering considerations.**

- **In the maintenance and repair of airport pavement, the long -term effects, rather than a short-term remedy, should be compared over some finite period of time (life cycle).**

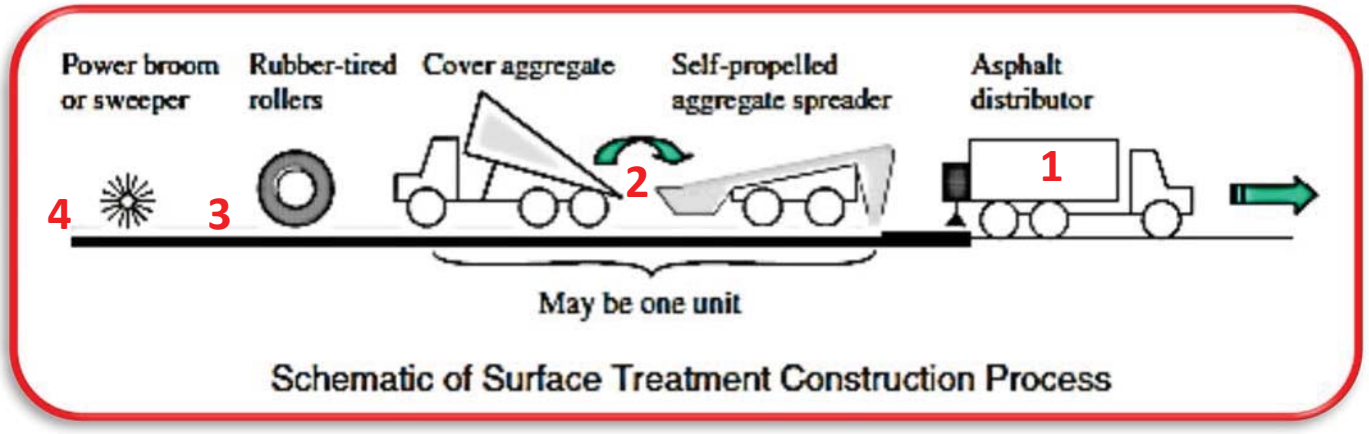
COMMON TECHNIQUES AND MATERIALS FOR MAINTENANCE AND REPAIR

- PORTLAND CEMENT CONCRETE (PCC)
- HOT- MIX ASPHALT (HMA)
- ASPHALT EMULSIONS
- TACK COAT
- PRIME COAT
- FOG SEAL
- AGGREGATE SEAL
- SLURRY SEAL
- COAL-TAR SEALER

PROCEDURES FOR MAINTENANCE AND REPAIR OF AC AIRFIELD PAVEMENTS

- ASPHALT SURFACE TREATMENT
- ASPHALT LEVELING COURSE
- HOT-MIX OVERLAY OF ASPHALT PAVEMENT
- MICRO SURFACING
- MICRO MILLING
- FOG SEAL PROCESS
- CHIP SEAL PROCESS
- SLURRY SEAL PROCESS
- MACHINE PATCHING OF PCC PAVEMENT WITH AC MATERIAL

ASPHALT SURFACE TREATMENT



Schematic of Surface Treatment Construction Process

Asphalt surface treatment is an application of asphalt materials to any type of pavement surface, **with or without** a cover of mineral aggregate, which produces an increase in thickness of less than one inch.

If with a cover of mineral aggregate such as surface seal, chip seal etc., then it is the application of asphalt binder, immediately followed by an application of cover aggregate, to any type of pavement surface.

Surface treatments can also be applied to AC pavements as a preventive or corrective maintenance treatment.

FIGURE 18-4 Pneumatic tire roller.

FIGURE 13-5 Material transfer vehicle.

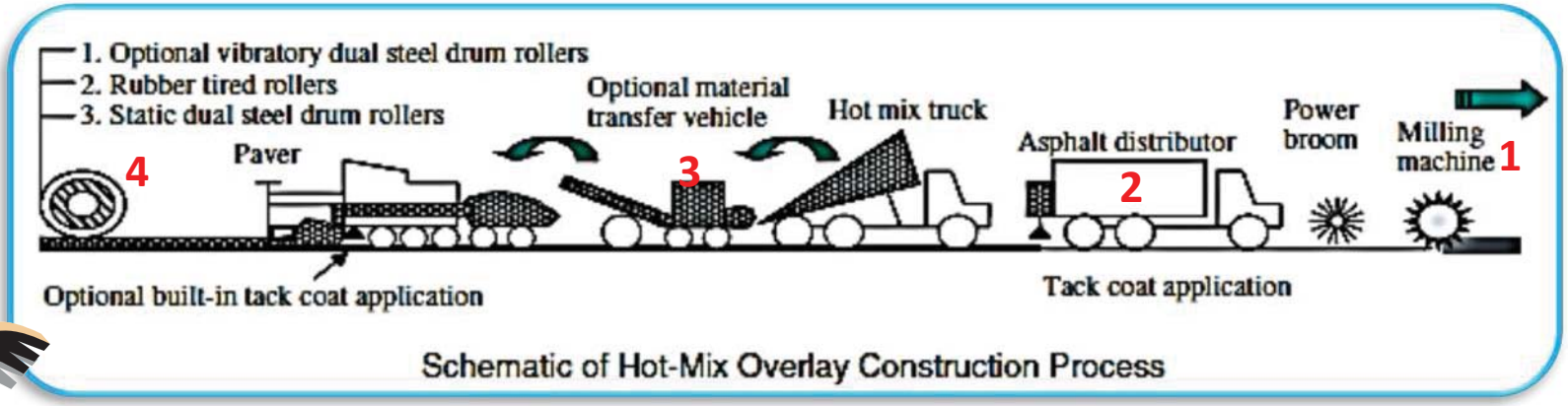
FIGURE 14-7 Distributor applying tack coat.

ASPHALT LEVELING COURSE

A layer (asphalt aggregate mixtures) of variable thickness used to eliminate irregularities in the contour of an existing surface prior to conducting treatment or construction.

Irregularities in the asphalt surface

HOT-MIX OVERLAY of ASPHALT PAVEMENT



Schematic of Hot-Mix Overlay Construction Process

Hot-mix overlay of AC pavement consists of placing a layer or layers of hot mix over the existing AC surface.

The construction of an overlay includes:

- milling of the pavement surface
- application of a tack coat
- the use of a Hot-Mix material transfer vehicle
- paving the surface
- compact with the roller

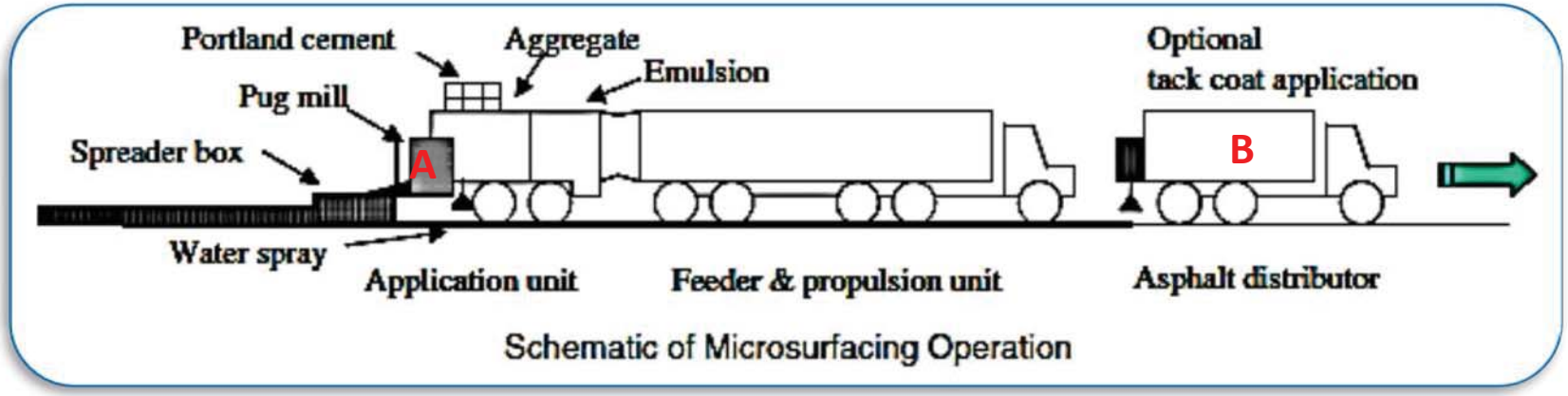
FIGURE 14-5 Typical milling machine.

FIGURE 17-15 Compaction of longitudinal joint with pneumatic tire roller.

FIGURE 13-5 Material transfer vehicle.

FIGURE 14-7 Distributor applying tack coat.

MICRO SURFACING



Schematic of Microsurfacing Operation

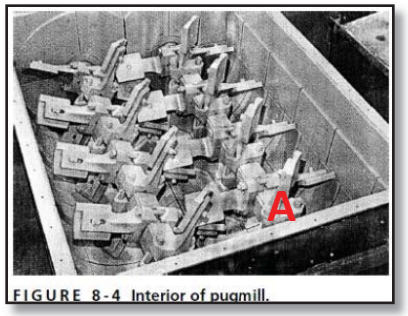


FIGURE 8-4 Interior of pugmill.

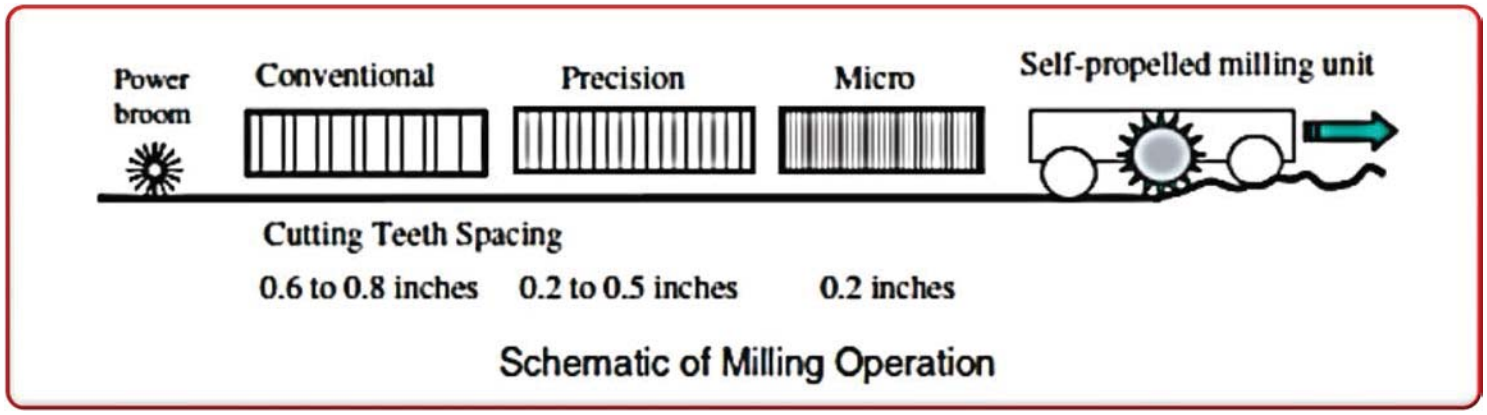
FIGURE 14-7 Distributor applying tack coat.

Micro-surfacing is an unheated mixture combination of polymer-modified asphalt emulsion, high-quality frictional aggregate, mineral filler, water, and other additives, mixed and spread over the pavement surface as a slurry.

The construction of micro-surfacing using a self-propelled truck-mounted continuous-feed mixing machine is illustrated by the diagram above.

MICRO MILLING

(Texturization Using Fine Milling)

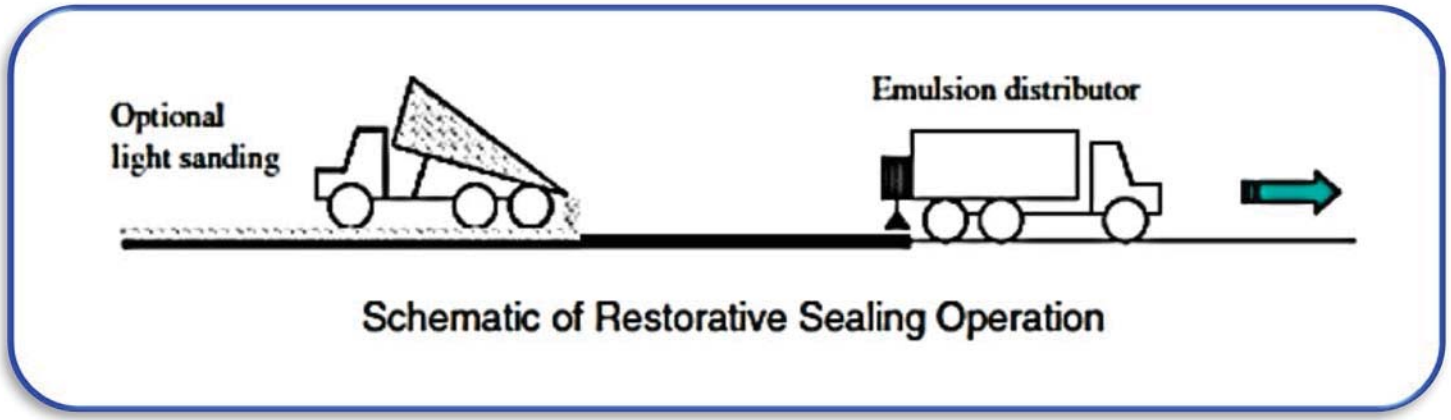


Texturization techniques include conventional milling, precision milling, and fine milling. **Fine milling, also called micromilling**, removes unevenness from the pavement surface or improves its texture, and leaves an abraded surface that can be used as a driving surface.

Milling is done by a cylindrical milling drum with closely spaced carbide-tipped tools (teeth). The techniques differ by the spacing of the cutting teeth, as shown on the above illustration, and by the degree of control over the profile of the milled surface.

FOG SEALS

(Restorative Seals)

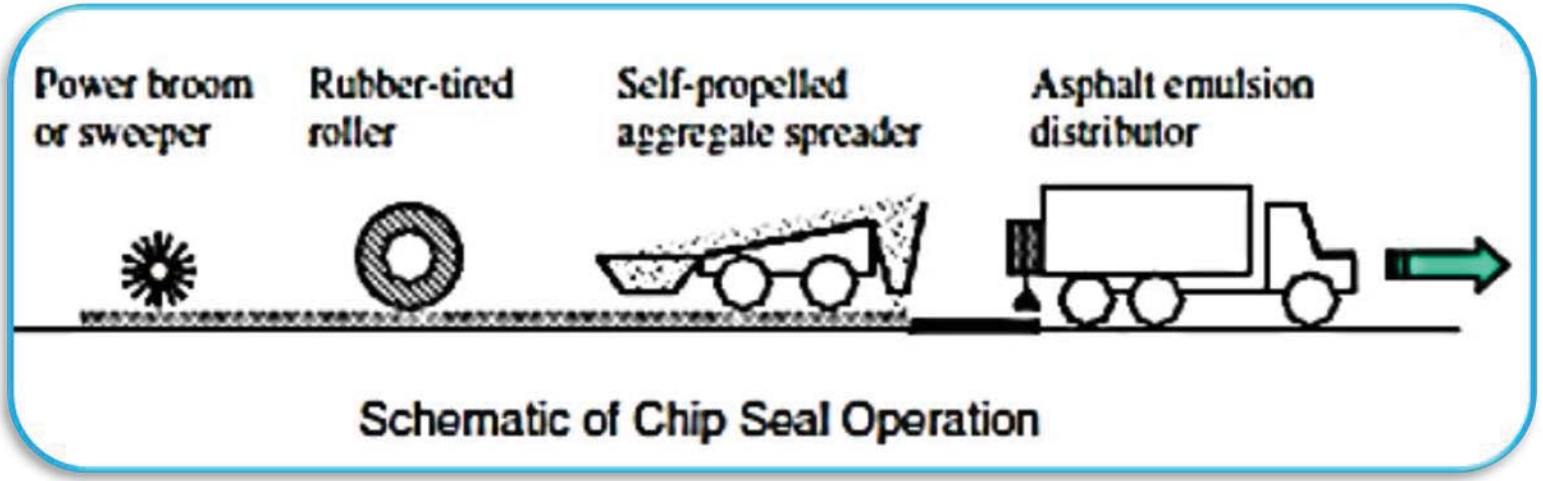


Schematic of Restorative Sealing Operation

Fog Seals consist of an application of a bituminous or coal-tar material, typically emulsion-based, to the surface of AC pavement as shown above.

Some agencies or suppliers recommend light sanding of fog seals (approximately 1 lb of sand per square yard).

CHIP SEAL PROCESS



Schematic of Chip Seal Operation

Surface treatment (also known as surface seal, seal, and **chip seal**) is the application of asphalt binder, immediately followed by an application of cover aggregate, to any type of pavement surface.

If the aggregate is of uniform size, the treatment is usually called chip seal.

SLURRY SEAL PROCESS

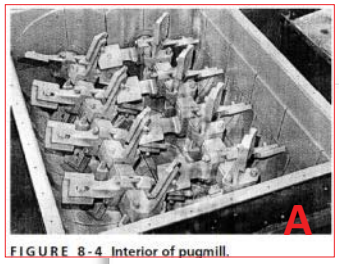
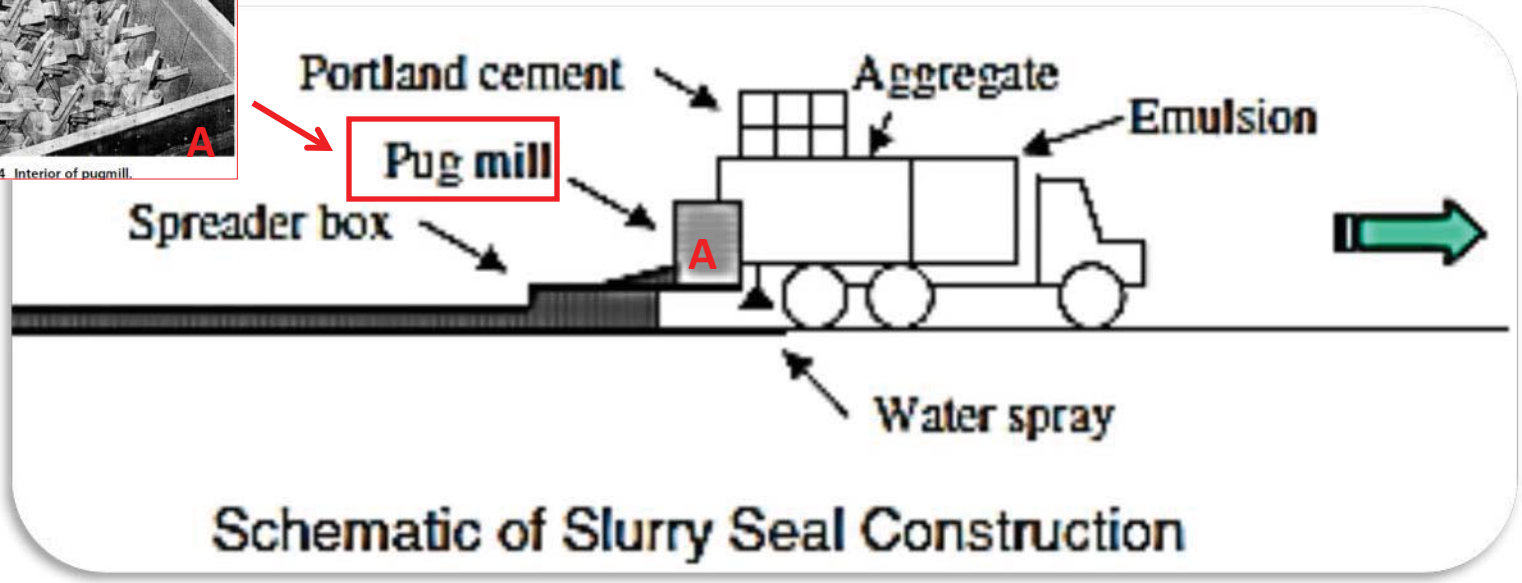


FIGURE 8-4 Interior of pugmill.

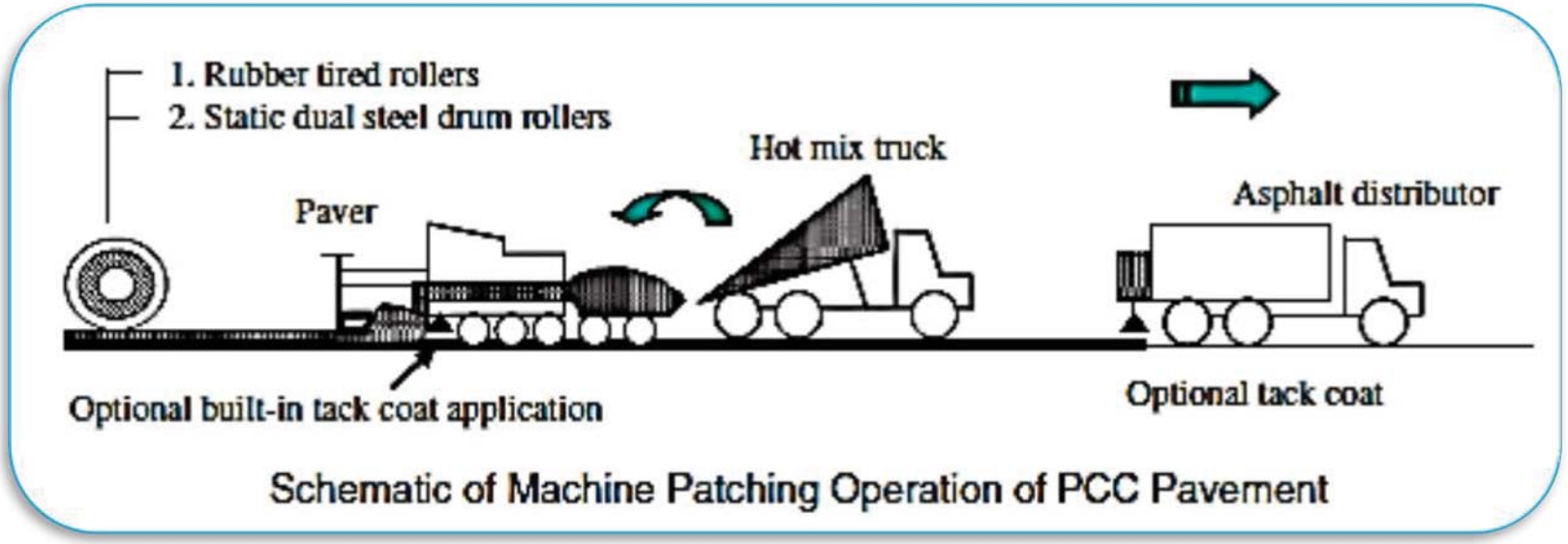


Schematic of Slurry Seal Construction

Slurry seal is an unheated mixture of a combination between asphalt emulsion, graded fine aggregate, mineral filler, water, and other additives, mixed and uniformly spread over the pavement surface as slurry.

The construction of slurry seal using a self-propelled truck-mounted mixing machine is illustrated above.

MACHINE PATCHING OF PCC PAVEMENT WITH AC MATERIAL



Schematic of Machine Patching Operation of PCC Pavement

Machine patching of PCC pavements is a maintenance technique that involves the placing and spreading of AC mix using a paver on parts of a pavement section. Machine patching includes the preparation of the patching area, addition of the patching material, and compaction as shown on the illustration above.

PREPARATION FOR JOINT/ CRACK REPAIR (PCC)

- CRACK PREPARATION FOR PCC
- RANDOM CRACK SAW
- VERTICAL SPINDLE ROUTER
- SAND - BLASTING
- WATER - BLASTING
- DIAMOND GRINDING

CRACK PREPARATION for PCC

- Cracks **less than 3/16** (.2”) wide and without any surface spalling **do not** require repair or sealing.
- Seal all cracks between 3/16 in and 2 in.(.2” – 2”) wide.
- Cracks **larger than 2 in**. require full-depth patching.
- Use of a **backer rod** is recommended for all crack sealing, unless other wise.
- **Rout or saw** the cracks to the proper depth and width according to the shape factor, or as designated by the manufacturer’s recommendations for the particular sealant being employed.
- After completion of the **sawing operation**, sandblast the crack face to remove laitance, sawing debris, and other foreign material.
- Conduct the **sandblasting operation** with a multiple-pass technique in which one side of the sawed crack face is abraded, followed by the other face.
- The pavement surface directly adjacent to the sawed crack may also **be blasted to remove any debris or materia**l that may cause problems during crack sealing.
- **Cracks are sealed as soon as possible** to prevent contamination before sealant application. If vegetation is growing in the cracks, remove it.

RANDOM CRACK SAW

A. Sawing is the preferred method for preparing cracks for sealing.

B. This device is essentially a concrete saw but has a smaller rear-mounted blade approximately 7 inches in diameter.

C. These saws are generally self-propelled machines with caster wheels that allow more freedom of movement than an ordinary concrete saw for following the path of cracks.

D. Use diamond blades manufactured for tracing cracks, which are wide enough to cut each edge of the crack and will not warp during operation.

Random Crack Saw

A freshly sawed crack.

VERTICAL SPINDLE ROUTER

A. Cracks may be routed out if a saw is not available.

B. The vertical spindle router has a vertically mounted router bit and is constructed such that the device can caster and easily follow the contours of a crack.

C. The bit must be the proper size for the sealant reservoir and be belt-driven for safety considerations arising from jamming of the bit if the router is forced along the crack.

D. Use proper size bits that yield the proper shape for the sealant reservoir and do not cause spalling or raveling along the crack path.

ROUTER USED TO SHAPE SEALANT RESEVOIR FOR CRACKS

SAND - BLASTING

A. Clean the crack faces by light sand-blasting using the multiple pass technique.

B. While standing to one side of the crack, pass the wand along the crack face at an angle to allow a strong blast on one crack face; then step to the other side of the crack and reverse direction.

C. Direct the nozzle to the location where the sealant will bond to the concrete, and not above or below this region.


Sand blasting

WATER - BLASTING

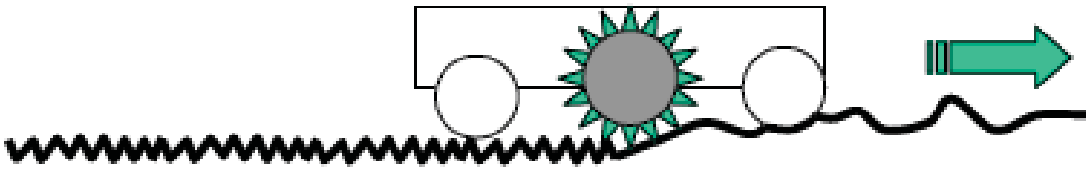
A. Water-blasting is another technique for cleaning crack faces. It is sometimes employed as an alternative to sandblasting due to local air regulations, or where the sand and debris might create additional problems.

B. After water-blasting is completed, dry the entire crack prior to sealant installation.

HIGH-PRESSURE WATER CLEANING

<u>NOTE:</u> Water-blasting is not necessary when sand-blasting is employed.

DIAMOND GRINDING



Schematic of Diamond Grinding Operation

Diamond grinding is a rehabilitation technique that removes a shallow depth of pavement surface material. The process is similar to a wood plane; the front wheels pass over a fault/bump, the cutting head shaves it off, and the rear wheels ride in a smooth path left by the cutting head.

The purpose of diamond grinding is to enhance the pavement smoothness, improve the pavement surface friction, and correct faulting on the aging pavements.

Figure 9.1. Diamond grinding equipment.

PCI – DISTRESS CONDITION – REPAIR SOLUTION

PCI Rating	Description	Applicable Pavement Preservation Treatments
86–100	Good—only minor distresses	Routine maintenance only
71–85	Satisfactory—low and medium distresses	Preventive maintenance
56–70	Fair, some distresses are severe	Corrective maintenance and rehabilitation
41–55	Poor—severity of some of the distresses can cause operational problems	Rehabilitation or reconstruction
26–40	Very poor—severe distresses cause operational problems.	Rehabilitation and reconstruction
11–25	Serious—many severe distresses cause operational restrictions	Immediate repairs and reconstruction
0–10	Failed—pavement deterioration prevents safe aircraft operations	Reconstruction

SEVERITY → MAINTENANCE TREATMENT (AC / PCC)

EXAMPLE OF MAINTENANCE POLICY FOR CRACKING

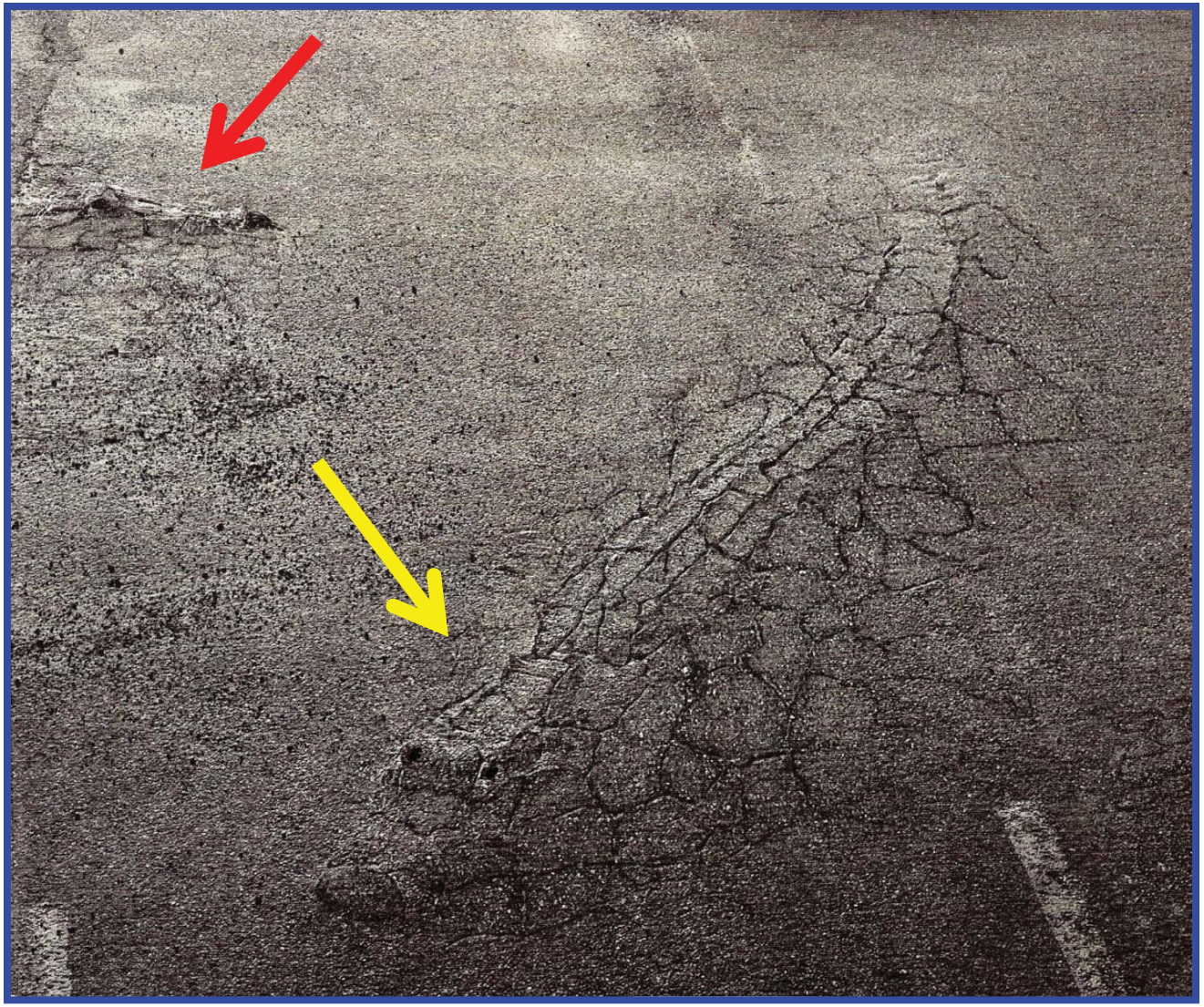
Severity of Pavement Cracking	Recommended Maintenance Treatment	
	AC pavements	PCC pavements
Low	None—continue to monitor	None—continue to monitor
Medium	Crack routing and sealing	Crack sealing
High	Crack repairs	Full-depth repairs

PROBABLE CAUSES & REPAIR SOLUTIONS FOR AIRFIELD AC SURFACES

DISTRESSES IN FLEXIBLE AIRFIELD PAVEMENTS

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST EROSION
7. JOINT REFLECTION CRACKING
8. LONGITUDINAL / TRANSVERSE CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING
13. RUTTING
14. SHOVING FROM PCC SLAB
15. SLIPPAGE CRACKING
16. SWELLING
17. WEATHERING

ALLIGATOR CRACKING



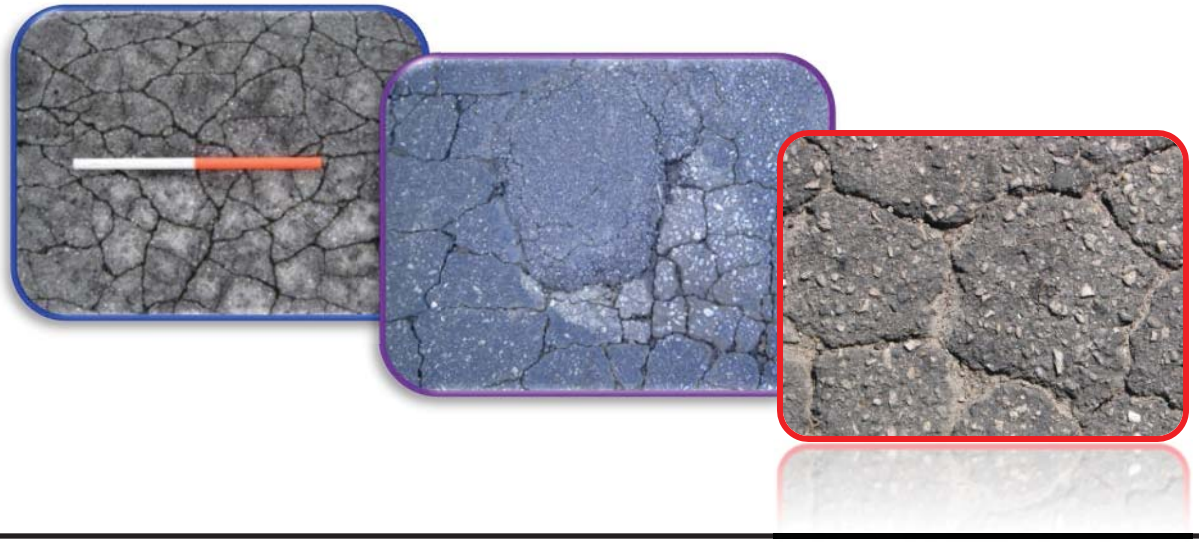
ALLIGATOR CRACKING

PROBABLE CAUSE	REPAIR
Alligator is caused by: - Overload - Oxidized binder - Under-designed surface course (too thin)	**T/E:** - Slurry seal (emulsified asphalt) - Seal coat (coal-tar pitch emulsion) **P** : - Saw cut area, remove and replace (State DOT modified surface mix) (*)

Note:

Sometimes alligator cracking is also the result of saturated bases or sub-bases, therefore correction may include removing the wet material and installing needed drainage.

(*) State DOT modified surface mix" refers to a modified standard mix with a minimum of **5%** retained on the **1/2-inch** (12.7 mm) sieve and 0% passing the **3/4-inch** (19 mm) sieve.



BLEEDING

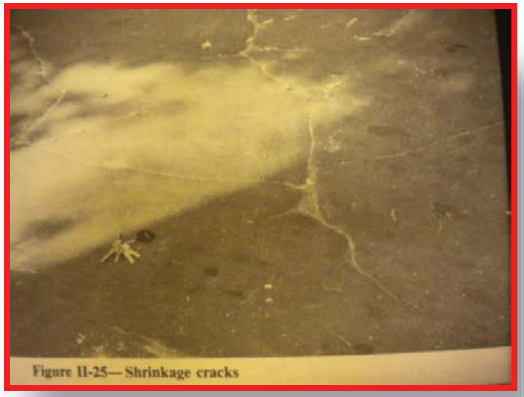
PROBABLE CAUSE	REPAIR
The most common cause of bleeding: - too heavy a prime or tack coat - too rich a mix, and/or - improperly constructed seal coat	**R/P:** - Scrap surface and blotter-sand-roll (blotter-sand) - Mill and repave (FAA P- 401)

Also, traffic may cause added compression of a pavement, containing too much asphalt, forcing it to the surface.

Figure II-67—Bleeding asphalt

BLOCK CRACKING

PROBABLE CAUSE	REPAIR
The cause of Block Cracking is: - aging - shrinkage of the asphalt concrete (AC), and, - daily temperature cycling (oxidation).	**Low**: <1/8": R/P: No action. T/E: Seal coat, Slurry seal or Fog seal **Medium**: ≥1/8"<3/4" R/P: Rout, clean & seal **High**: ≥3/4"<1-1/4" R/P: Saw, mill, remove & replace T/E: Rout edges only, clean & seal **High**: ≥ 1-1/4" - 2-1/4" R/P: Remove & replace T/E: Rout edges only, clean, install backer rod & seal



CONTAMINANTS

PROBABLE CAUSE	REPAIR
A contaminant is usually caused by: - Aircraft take off and landing	**L:** R/P: Clean surface (Biodegradable chemicals) **M:** R/P: - Clean surface and apply coal-tar/ emulsion seal coat (coal-tar pitch emulsion) **H:** R/P: - Remove and replace (State DOT modified surface mix) FAA P401

Rubber deposits may be removed by the use of high -pressure water or biodegradable chemicals.

CORRUGATION

PROBABLE CAUSE	REPAIR
Corrugations usually occurs in asphalt layer that lack stability which may be caused by: - a mixture that is too rich in asphalt - has too high a proportion of fine aggregate - has asphalt cement that is too soft, or - excessive moisture, contamination due to oil spillage	**R/P :** - Saw cut area, remove and replace (State DOT modified surface mix) (FAA P 401) **T/E :** - Slurry seal (emulsified asphalt) - Seal coat (coal-tar pitch emulsion)

Also, traffic action combined with an unstable pavement surface or base usually causes this type of distress.

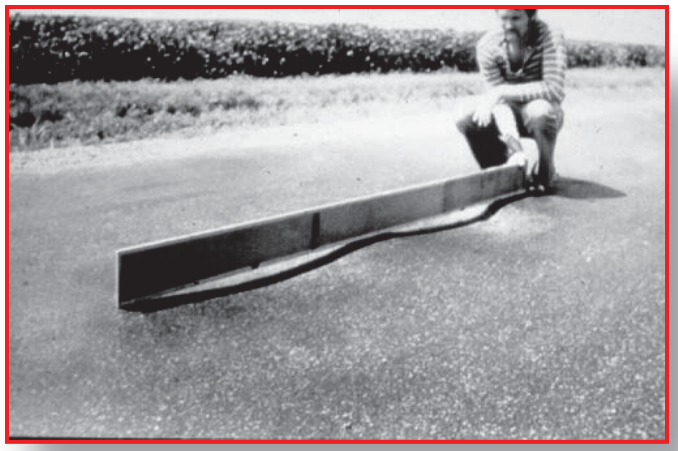


Figure II-45—Corrugations

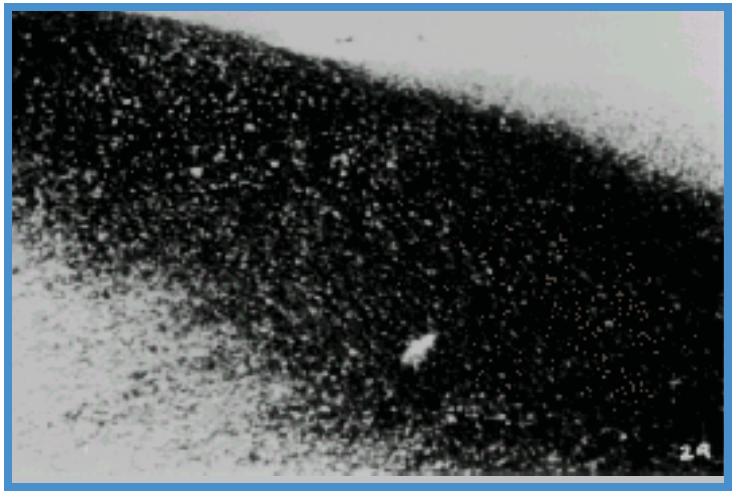
<u>According to the AC150/5380-6:</u> The repair procedure for **Corrugation** is the same as for patch repair of **Shoving**.

DEPRESSION

PROBABLE CAUSE	REPAIR
The cause of Depression is: - traffic heavier than what it was originally designed for - by settlement of the lower pavement layers, or - poor construction methods - lack of compaction - Unstable mix (too rich, poor aggregate gradation)	**R/P:** - Remove and replace (State DOT modified surface mix) (FAA P401)

JET BLAST EROSION

PROBABLE CAUSE	REPAIR
Jet blast erosion is caused by: - the heat, - burns, or - carbonization, which resulted in jets landing at the airport. It may vary in depth, but normally ≤ .5”.	**T** : - No action / Apply rejuvenator **P**: - Partial-depth patch

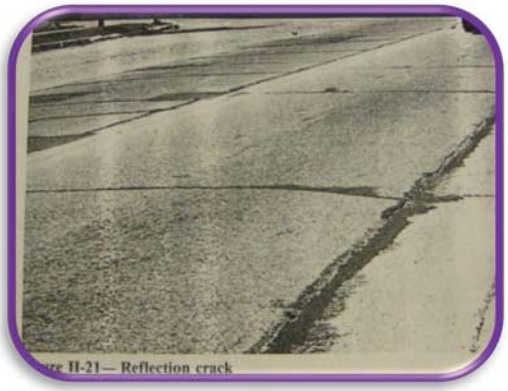


JOINT REFLECTION CRACKING FROM PCC

(From Longitudinal and Transverse Of PCC Slabs)

(Not Load related)

PROBABLE CAUSE	REPAIR
Joint Reflection Cracking from PCC is caused by: - Vertical or horizontal movements of the PCC slabs beneath the AC surface . - Traffic loading may also cause a breakdown of the AC near the crack, resulting in spalling and FOD potential.	**See:** Repair for **Block** or **LT Cracking**



NOTE: According to the AC150/5380-6B:
The repair procedure for **Joint Reflection Cracking** is the same as for the **L.T**. and **Block Cracking**.

LONGITUDINAL & TRANSVERSE CRACKING

(NON-PCC Joint Reflective)

PROBABLE CAUSE	REPAIR
LONGITUDINAL may be caused by: 1. A poorly constructed paving lane joint 2. Shrinkage of AC surface or hardening of the asphalt 3. A reflective crack caused by cracks beneath the surface course, including cracks in PCC slabs **TRANSVERSE** may be caused by: (2) or (3)	**See:** Repair for **Block** or **Joint Reflection Cracking**

OIL SPILL

PROBABLE CAUSE	REPAIR
It's caused by: - the spilling of oil, - fuel, or - other solvents	**R/P**: <u>Isolated Areas :</u> L: Clean w/ application of biodegradable chemicals M: Clean and application of coal-tar emulsion seal coat <u>Areas of continuous spillage</u> H: Remove and replace

PATCHING & UTILITY CUT PATCH

PROBABLE CAUSE	REPAIR
The causes of utility-cut depressions are: - inadequate backfill compaction - too much backfill results in an utility cut that is raised above the pavement level - to correct or improve the existing airfield pavement condition.	**L:** - No action **M:** T/E: - Seal crack - Repair distressed area (small) only R/P: - Remove and replace the patch **H:** R/P: - Remove and replace the patch (see SAW CUT, REMOVE, AND REPLACE..)

POLISHED AGGREGATE

PROBABLE CAUSE	REPAIR
The cause of Polished Aggregate is: • Soft aggregates such as limestone, will become polished quickly under traffic • Naturally polished. • Heavy repeated traffic.	**R/P** - Slurry seal (emulsified asphalt) - Micro-milling - Diamond grinding - Grooving - Overlay (P 401)

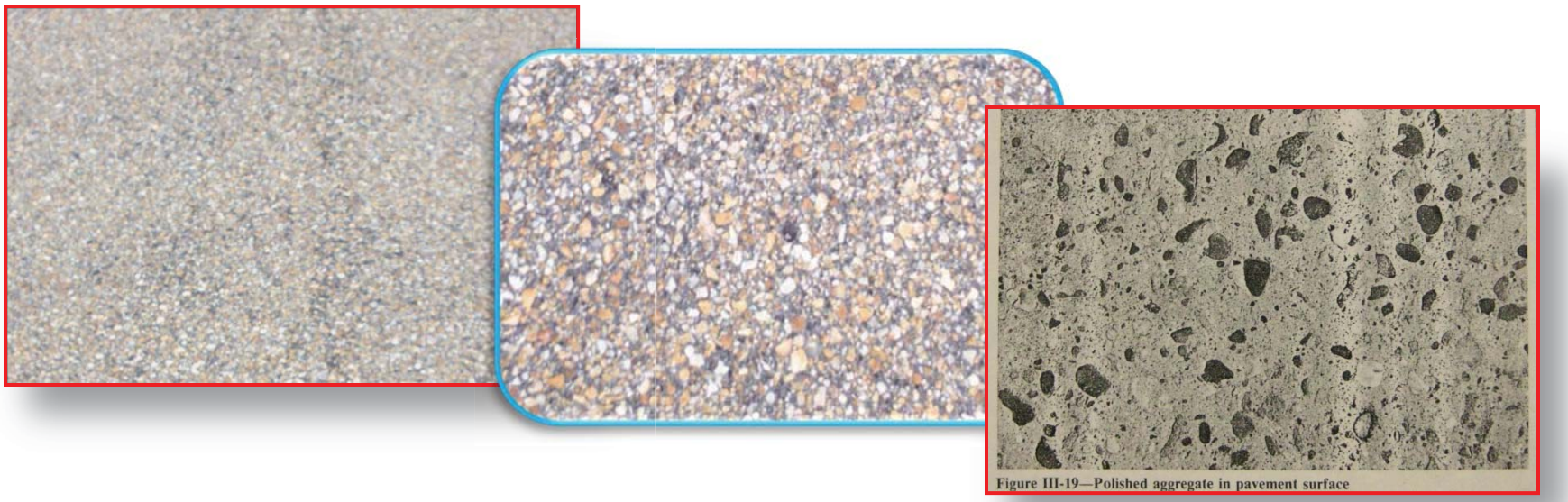


Figure III-19—Polished aggregate in pavement surface

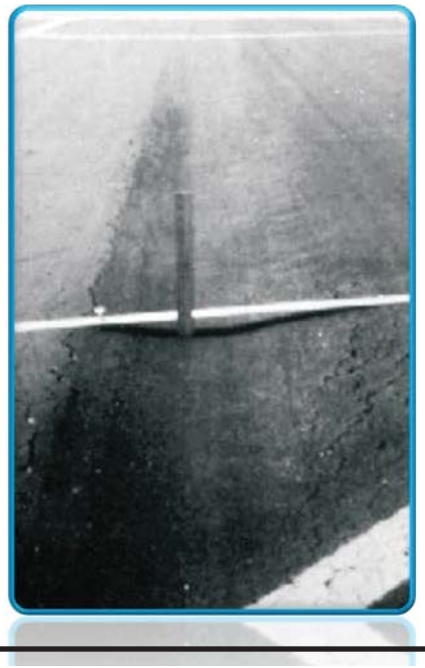
RAVELING

PROBABLE CAUSE	REPAIR
Raveling is caused by: - lack of compaction - construction activity during cold weather - unsuitable aggregate (dirty or disintegrating) - lack of asphalt in the mix, or over-heating of the asphalt mix.	<u>For small area</u>: **R/P :** - Remove and replace **T/E :** - Seal coat (coal-tar pitch emulsion) - Slurry seal (emulsified asphalt) - Apply rejuvenator (sealer-rejuvenator) <u>For large area</u>: **R/P :** - Overlay **T/E :** **(**As for the small area)

High-Severity Raveling, Dense Mix

RUTTING

PROBABLE CAUSE	REPAIR
Rutting is caused by: - a permanent deformation of one or more underneath layers. - lack of compaction during construction. - consolidation or lateral movement of the materials due to traffic loads.	**R/P :** - Remove and replace **T/E :** - Patch w/ elastomeric compound w/ aggregate



SHOVING OF ASPHALT PAVEMENT BY PCC SLABS

PROBABLE CAUSE	REPAIR
Shoving is the localized bulging of a pavement surface. It can be caused by: - lack of stability in the mix, or - lateral stresses produced by adjacent PCC pavement during expansion.	**R/P :** - Saw cut area, remove and replace (State DOT modified surface mix) (FAA P401) **T/E :** - Slurry seal (emulsified asphalt) - Seal coat (coal-tar pitch emulsion)

According to the AC150/5380-6B: Repair procedure for **SHOVING** is the same as for **CORRUGATION**

SLIPPAGE CRACKING

PROBABLE CAUSE	REPAIR
Slippage cracks appear when: - braking or turning wheels cause the pavement surface to slide and deform - low-strength surface mix, or - poor bond between the surface and the next layer of the pavement structure.	**R/P :** - Remove and replace (State DOT modified surface mix) (FAA P401) **T/E :** - Crack seal (hot/cold –applied) - Slurry seal (emulsified asphalt)

These cracks are crescent or half-moon-shaped with the two ends pointing away from the direction of traffic.

Figure II-30—Slippage cracks

SLIPPERINESS

PROBABLE CAUSE	REPAIR
A Slipperiness is usually caused by: - Overly rich mix - Poorly designed mix - Polished aggregate - Improperly applied seal coat - Wrong kind of seal coat - Rubber deposits	- Apply textured seal coat - Grooving - Remove rubber.

SWELL

PROBABLE CAUSE	REPAIR
A swell is usually caused by: - frost action surrounding dissimilar material types in the subgrade, or - swelling soil.	**R/P :** - Saw cut area, remove and replace (State DOT modified surface mix) (FAA P401) **T/E :** - Slurry seal (emulsified asphalt) - Seal coat (coal-tar pitch emulsion)

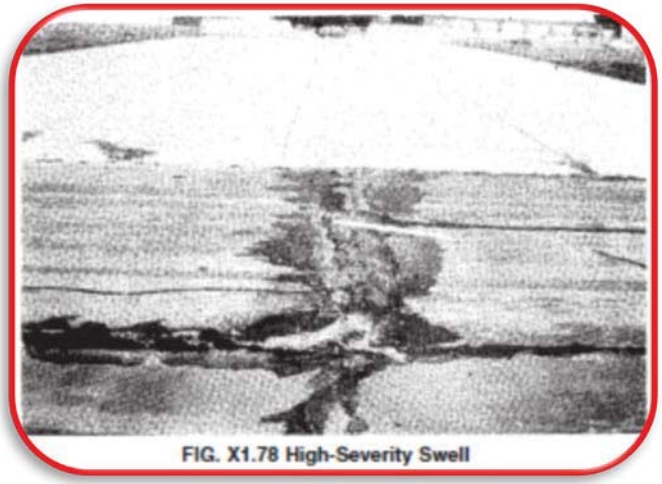
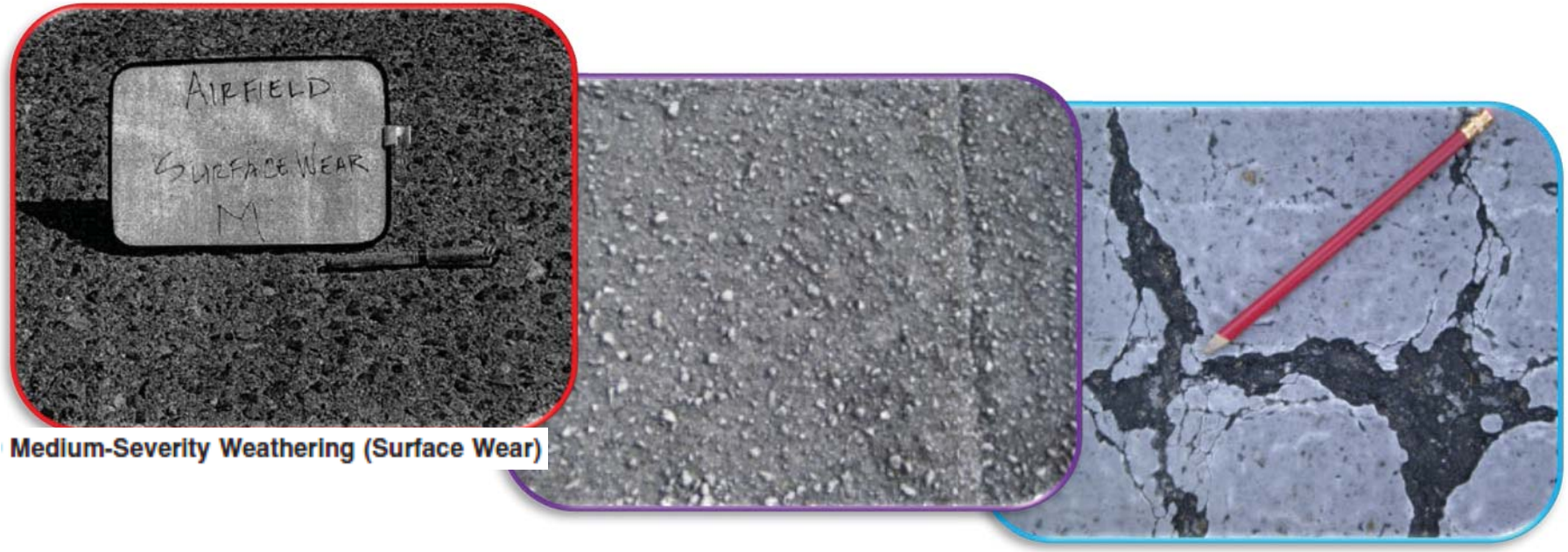


FIG. X1.78 High-Severity Swell

NOTE: Corrugation and Shoving or Swelling. The repair procedure for these types of distresses is the same as for **patch repair of alligator cracking,(p. 31 AC 150/ 5380-6B).**

WEATHERING

PROBABLE CAUSE	REPAIR
PROBABLE CAUSE: Weathering is caused by: - aging - climatic weather condition	<u>For small area</u>: **R/P :** - Remove and replace **T/E :** - Seal coat (coal-tar pitch emulsion) - Slurry seal (emulsified asphalt) - Apply rejuvenator (sealer-rejuvenator) <u>For large area</u>: **R/P :** - Overlay **T/E :** (As for the small area)



Medium-Severity Weathering (Surface Wear)

<u>Note</u>: Surface wear is not recorded if medium or high severity raveling is recorded.

Classroom session for Distress Repair was conducted at the Orlando FDOT Aviation Office

Field repair application for Distress Repair was conducted at the Orlando Executive Airport

PROBABLE CAUSES & REPAIR SOLUTIONS

FOR

AIRFIELD PCC SURFACES

DISTRESSES IN RIGID AIRFIELD PAVEMENTS

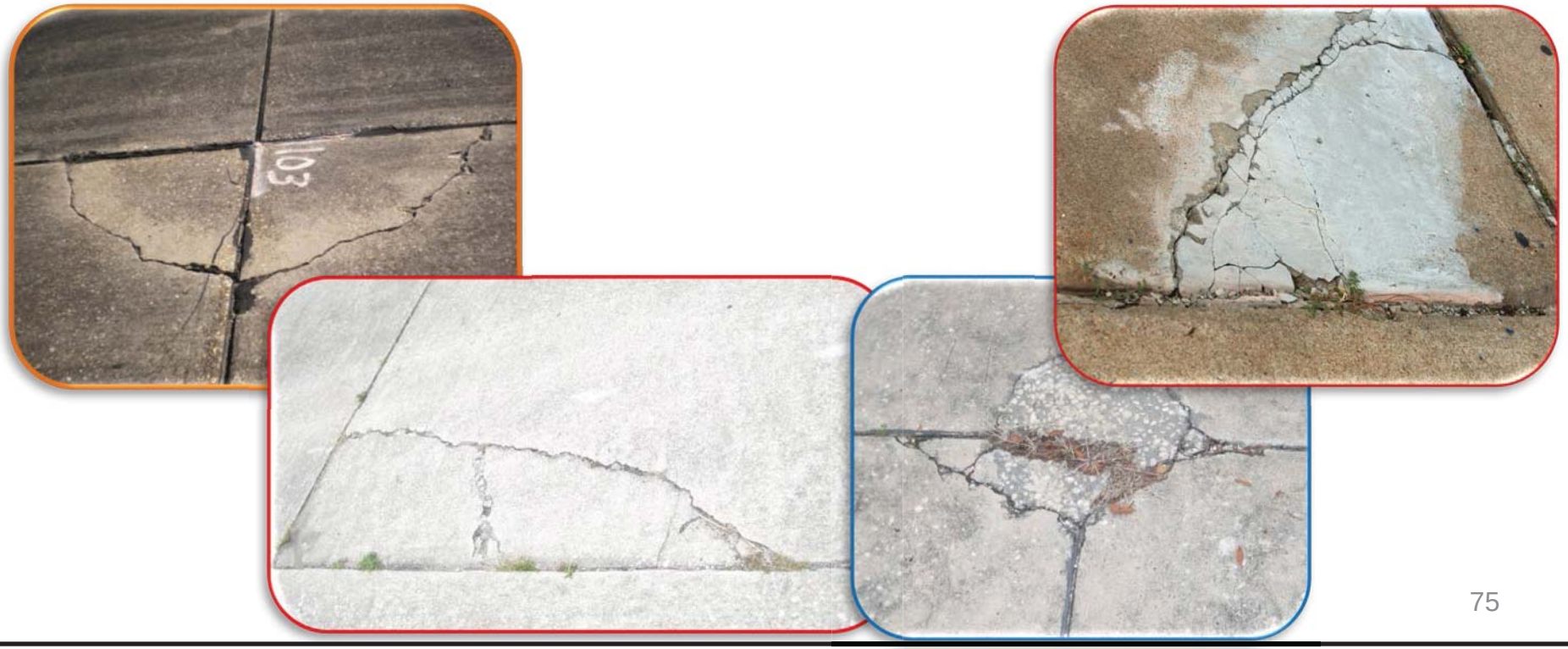
1. BLOW UP
2. CORNNER BREAK
3. LTD CRACKING
4. "D" CRACKING
5. JOINT SEAL DAMAGE
6. SMALL PATCH
7. LARGE PATCH
8. POPOUTS
9. PUMPING
10. SCALLING/ MAP CRACKING/CRAZING
11. FAULTING (SETTLEMENT)
12. SHATTERED SLAB
13. SHRINKAGE CRACKING
14. JOINT SPALLING
15. CORNER SPALLING
16. ALKALIS SILICA REACTIVITY

BLOWUP

PROBABLE CAUSE	REPAIR
Most Blow-up are caused by: - excessive expansion of the slab during hot weather. - The pressure builds up until the slab can not resist it any longer and they either buckle or shatter, crumbling along the transverse joint or crack. - Incompressible material in joints preventing slab from expanding - Alkali-Aggregate Reactivity	**R/P:** - Remove and replace concrete full-depth - clean, and - reseal joints.

CORNER BREAK

PROBABLE CAUSE	REPAIR
Corner cracks can be caused by: - traffic loads on unsupported corners or curled or warped slabs - they may also be caused by loads over weak spots in the sub-grade under the slabs.	**R/P:** - Pavement < 12" : Full-depth repair w. #4 rebar - Pavement > 12" : Full-depth repair w. #5 rebar - Joints parallel to the center line : Full-depth repair w. dowel bars



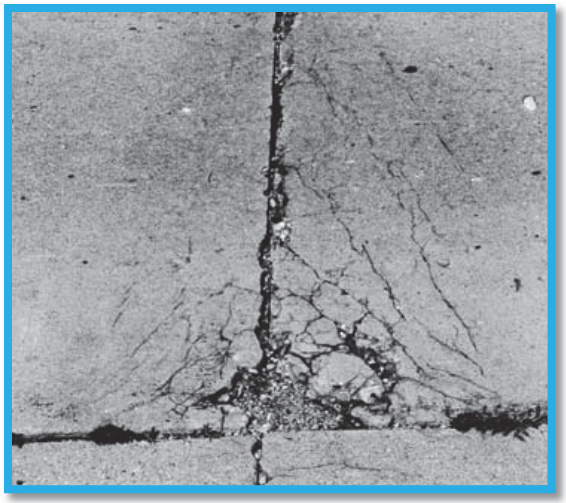
LTD CRACKING


Random Crack Saw

PROBABLE CAUSE	REPAIR
Some causes of Longitudinal Cracking are: - shrinkage of the concrete (if the pavement is too wide and has no Longitudinal joint) - expansive sub-base or sub-grade - warping stresses in combination with loads - loss of support from edge pumping **The causes of Transverse Cracks are:** - overloads - repeated bending of pumping slabs - soft foundations - lack of joints - too shallow joints, and - shrinkage of concrete	**R/P:** Low: - surface crack: No action Medium: - <1/8" : No action High: - ≥ 1/8" : Rotary-random saw and seal

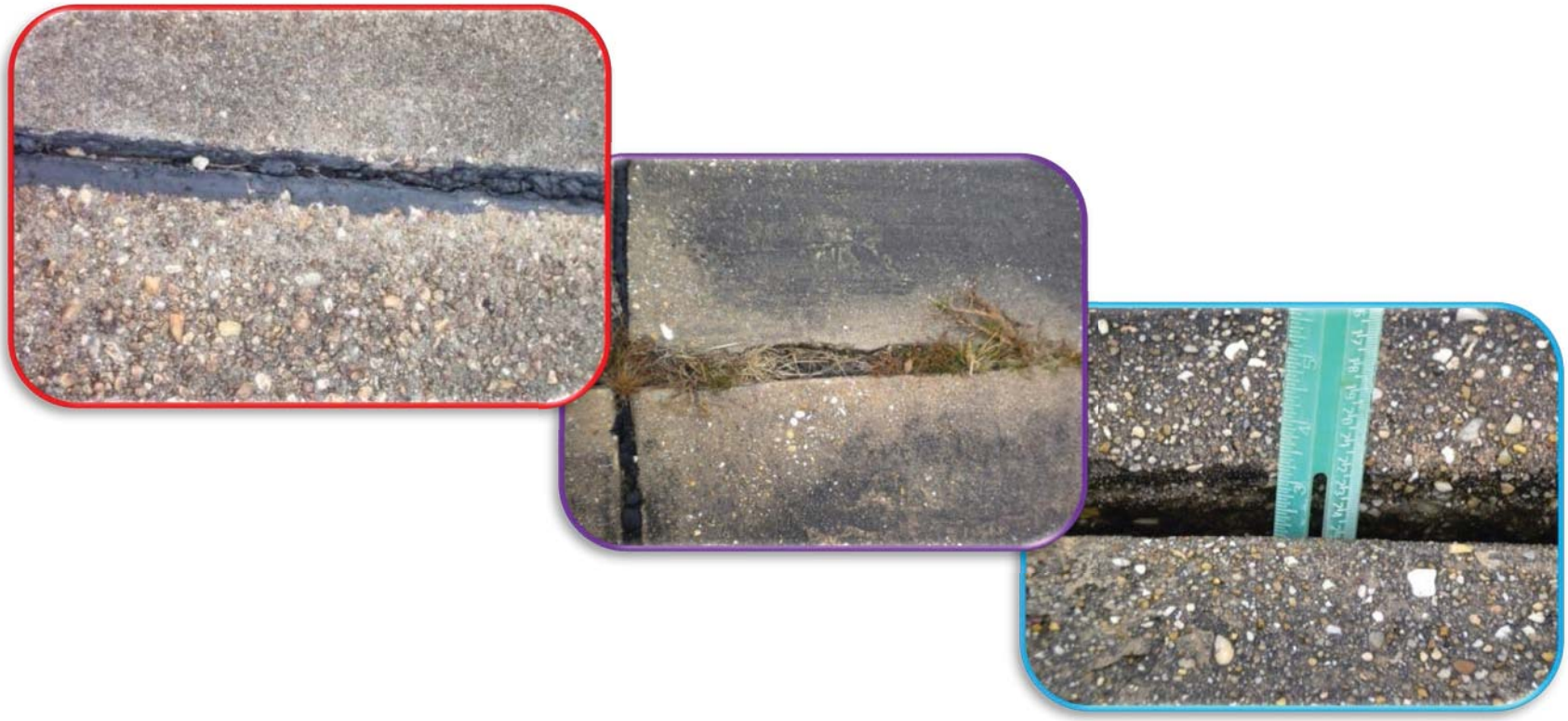
D-CRACKING

PROBABLE CAUSE	REPAIR
Durability cracking is caused by: The concrete's inability to withstand environmental factors, such as freeze-thaw cycles. This type of cracking may eventually lead to disintegration of the concrete within 1-2 feet of the joint or crack.	**R/P:** - Remove and replace entire slab **T/E:** - Same repair as Corner Breaks, Scaling, Map Cracking, or Crazing - Partial depth repair, mill 2-3" - See FULL-DEPTH REPAIR



JOINT SEAL DAMAGE

PROBABLE CAUSE	REPAIR
Joint Seal Damage is caused by: - Improper joint width - Use of the wrong type of sealant - Incorrect application - Not properly cleaning the joint before sealing	**R/P:** - Remove old and reseal joint



PATCHING (<5 SQ. FT.)

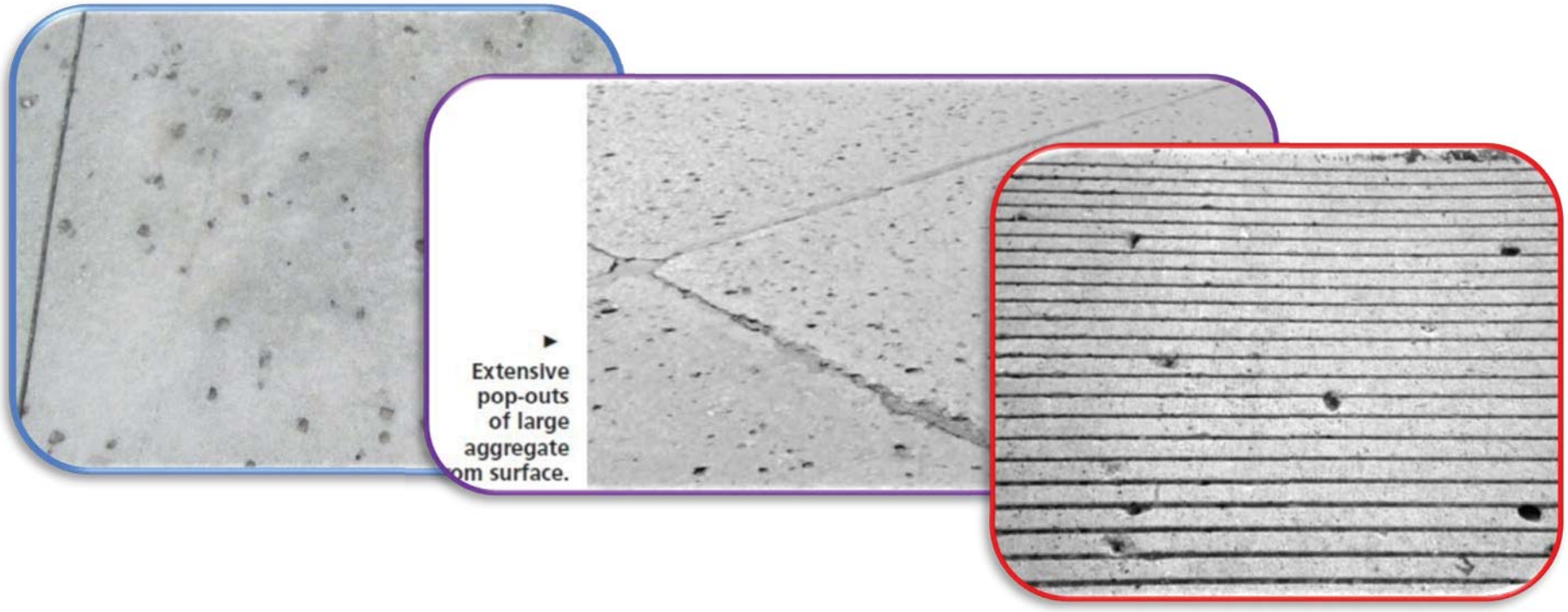
PROBABLE CAUSE	REPAIR
The reason of patching is: - To improve the existing pavement distresses' condition	**SMALL:** **L:** - No action **M**: R/P: - Remove and replace the patch T/E : - Seal cracks within patch **H**: R/P: - Remove and replace the patch

PATCHING (>5 SQ. FT.)

PROBABLE CAUSE	REPAIR
The reason of patching is: - To improve the existing pavement distresses' condition	**LARGE and UTILITY CUT:** **L:** - No action **M:** T/E : - Seal cracks within patch R/P: - Repair distress area only - Remove and replace the patch **H**: R/P : - Remove and replace the patch - (see FULL-DEPTH REPAIR)

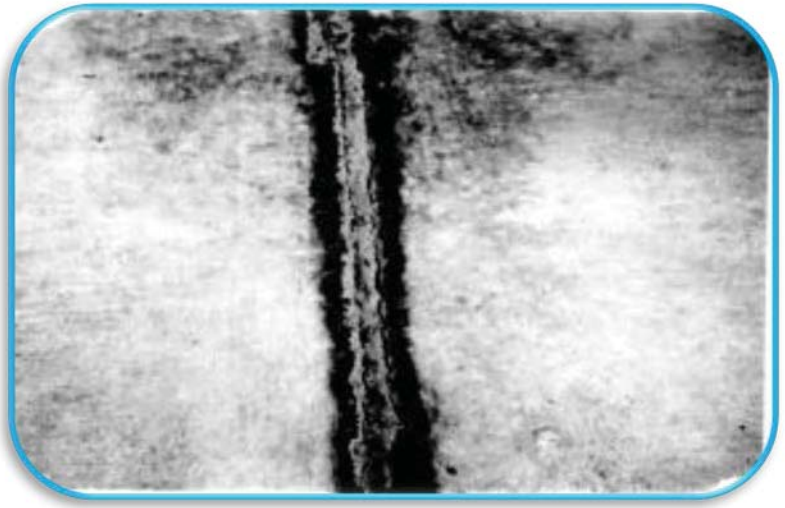
POP OUTS

PROBABLE CAUSE	REPAIR
Pop outs are caused due to: - freeze-thaw action in combination with expansive aggregates.	**R/P:** **L:** ≤ 2” diameter: - Seal (elastomeric compound) **M/H:** >2” diameter: - Patch w/ elastomeric compound with aggregate



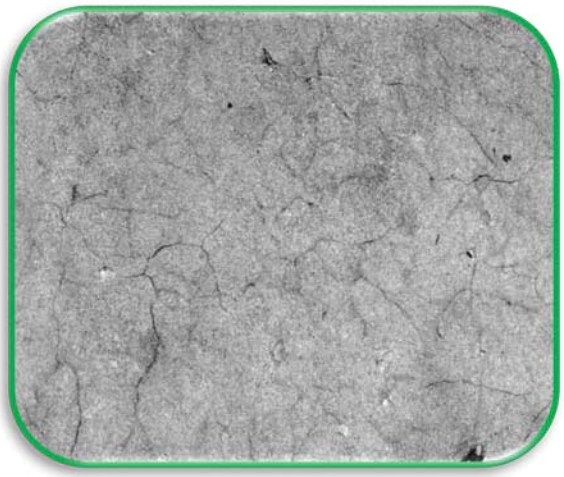
PUMPING

PROBABLE CAUSE	REPAIR
Pumping out of fine material is caused by: - Presence of free water on or in the sub-grade, or the sub-base along with heavy loads passing over the pavement surface and deflecting the slab	**R/P:** **L/M:** - base stabilization - slab leveling with cementitious grout pump under pressure through holes cored in pavement into void - expandable foam injection **H**: - base stabilization - slab leveling with cementitious grout pump under pressure through holes cored in pavement into void - install load transfer devices

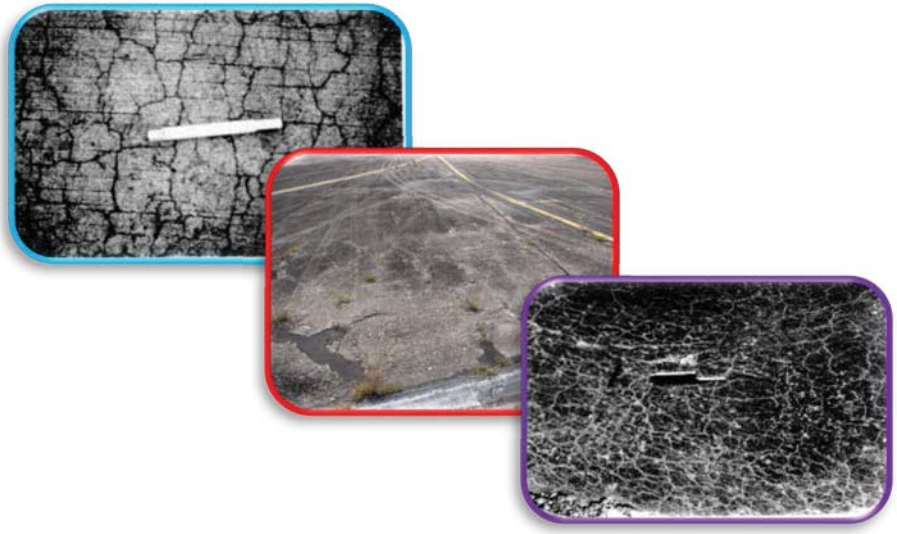


SCALING/ MAP CRACKING

PROBABLE CAUSE	REPAIR
Major causes of scaling are: - the chemical action of deicing salts - over finishing, improper mixing - unsuitable aggregates, and improper curing.	**L: R/P: -** Seal/ No action **M: T/E: -** Micro-mill and seal **H: R/P: -** Micro-mill to grade, install thin bonded overlay - Remove and replace if extensive area



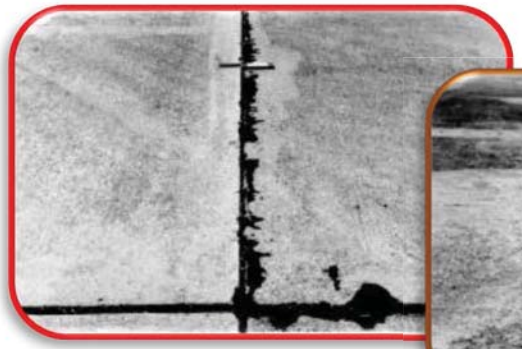
Map Cracking indicates a problem with the quality of the aggregate known as ASR (alkali-silica reactivity). If severe, cracks may spall or the surface may scale.



Medium-severity **scaling**

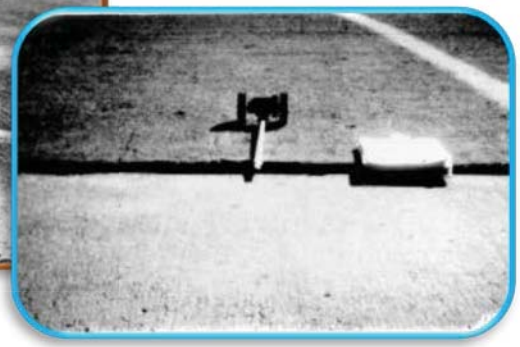
FAULTING (or SETTLEMENT)

PROBABLE CAUSE	REPAIR
Faulting usually develops from: - inadequate load transfer between slabs along with consolidation, or - shrinkage in volume with courses underlying the slabs. - pumping out of the foundation materials, or - upheaval	**R/P:** **L:** (w. no movement) - Micro-mill surface to true and level **M/H:** (movement) - Slabjacking with cementitious grout pump under pressure through holes cored in pavement into void - expandable foam injection



Low-severity settlement, 3/8".

Medium-severity settlement on apron >1/2 in.



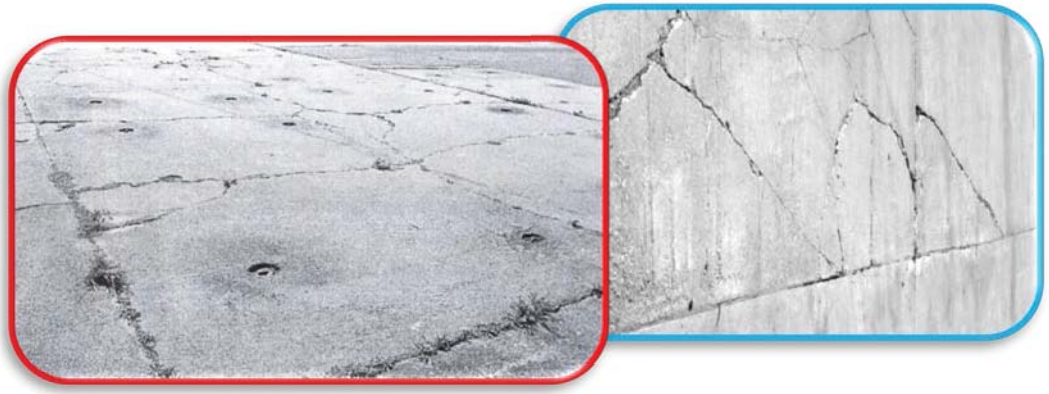
High-severity settlement on taxiway/runway, 3/4 in.

SHATTERED SLAB/INTERSECTINGCRACKS

PROBABLE CAUSE	REPAIR
Similar to the LTD, **some causes of shattered slabs are:** - shrinkage of the concrete - lack of joints, frozen" joints, too shallow joints - expansive sub-base or sub-grade, - warping stresses in combination with loads - overloading - weak foundations, or - loss of support from repeated bending of pumping slabs	**R/P:** - Remove and replace entire slab

Note:

A shattered slab requires replacing the full slab. Follow the same procedures used for blowup repairs except remove unstable sub-grade materials and replace with select material. Correct poor drainage conditions by installing drains for removal of excess water . Also: (see Full-Depth repair).



Shattered slab

Medium-severity intersecting *cracks*

Relationship between LTD, Intersecting Crack & Shattered Slab

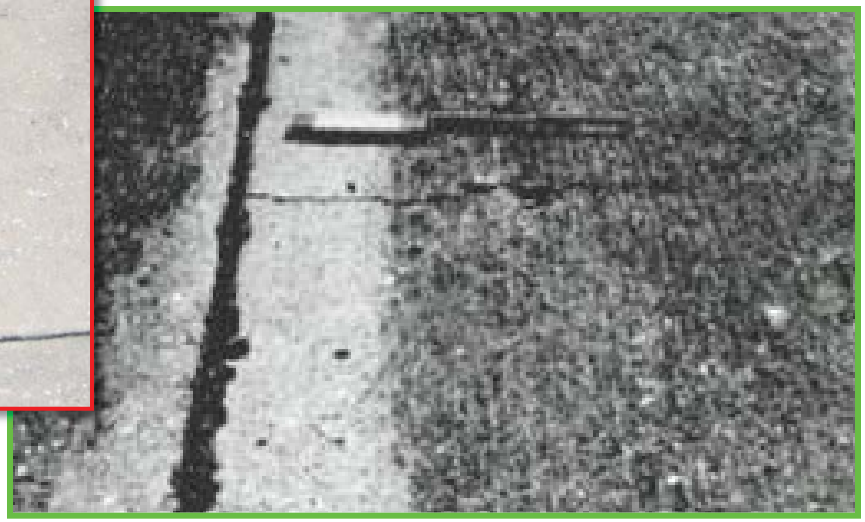
RELATIONSHIP BETWEEN THE NAMES & THE NUMBER OF BROKEN PIECES

Number of Pieces	Number of %	Cracks' Severity	Final Severity	Name of Cracks
≤ 3	n/a	n/a	n/a	LTD crack
4 or 5	>85	L	LOW	Intersecting Cr
4 or 5 ≥ 6	>15 >85	M (no H) L	MEDIUM MEDIUM	Intersecting C. Intersecting C.
4 or 5 ≥ 6	n/a >15	Some or all= H M or H	HIGH HIGH	Shattered Sl. Shattered Sl.

LTD ➡ INTERSECTING CRACK ➡ SHATTERED SLAB

SHRINKAGE CRACK

PROBABLE CAUSE	REPAIR
Shrinkage Cracks are non-structural and non-propagating. These types of cracks should be considered cosmetic and not subject to conventional repairs.	**R/P:** - No action - Fill voids w/ cement paste or epoxy cement



JOINT SPALLING

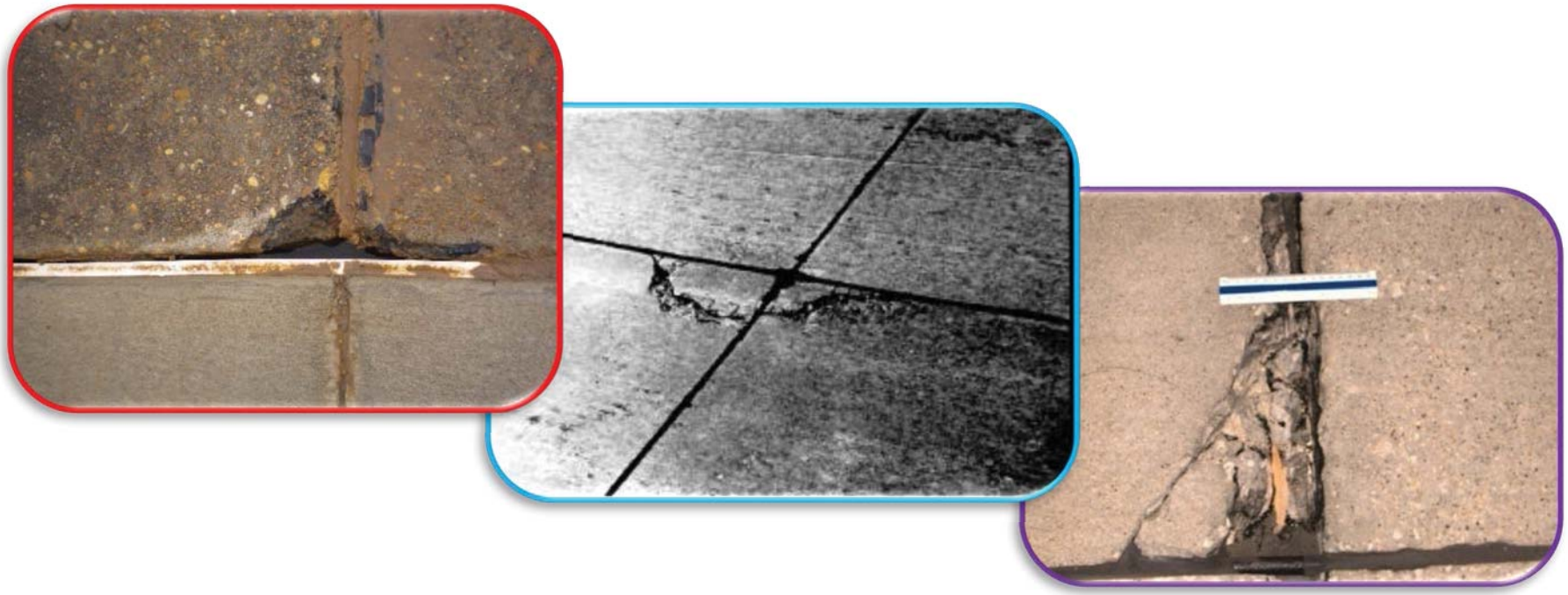
(TRANSVERSE AND LONGITUDINAL JOINTS)

PROBABLE CAUSE	REPAIR
Joints spalling result from: - excessive stress at the joint - infiltration of incompressible materials - traffic load - weak concrete at the joint (cause by over working) combined with traffic loads is another cause of spalling.	**R/P:** - Saw cut, remove unsound concrete and patch **T/E:** - Remove unsound concrete, patch

NOTE: Make sure a fray is not counted as a spall, unless it is greater than 2-ft long. A fray is when the edge becomes rough. Minimum width of spall is ½”

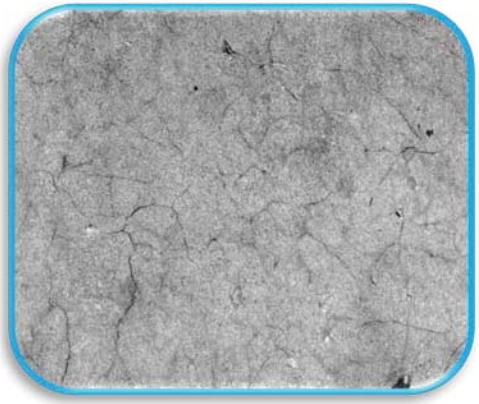
CORNER SPALLING

PROBABLE CAUSE	REPAIR
Corner spalling result from: - excessive stress at the corner - crack caused by infiltration of incompressible materials - traffic load, or - weak concrete at the corner (cause by over working) combined with traffic loads is another cause of spalling..	**R/P:** - Saw cut, remove unsound concrete and patch **T/E:** - Remove unsound concrete, patch



ALKALI SILICA REACTIVITY

PROBABLE CAUSE	REPAIR
Major causes of scaling are: - the chemical action of deicing salts - over finishing, - improper mixing - unsuitable aggregates, and - improper curing.	**L:** **R/P:** - Seal/ No action **M:** **T/E:** - Micro-mill and seal **H:** **R/P:** - Micro-mill to grade, install thin bonded overlay - Remove and replace if extensive area



Map Cracking indicates a problem with the quality of the aggregate known as ASR (alkali-silica reactivity). If severe, cracks may spall or the surface may scale.

POLISH AGGREGATE

PROBABLE CAUSE	REPAIR
It's caused by: • Naturally polished. • Heavy repeated traffic • Aging	**R/P:** - Micro-mill entire surface - Diamond grind entire surface - Grooving - Resurfacing * HMA pavement overlay * thin bonded PCC overlay

CONTAMINANTS

PROBABLE CAUSE	REPAIR
It's caused by: - the spilling of oil, - rubber deposits - fuel, or - other solvents.	**P:** - surface cleaning: - high-pressure water - biodegradable chemicals

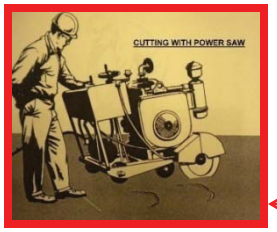
SLIPPERINESS

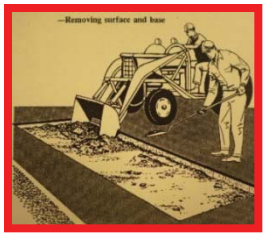
PROBABLE CAUSE	REPAIR
A Slipperiness is usually caused by: - Improper type of curing membrane - Excessive curing membrane - Polished aggregate - Rubber deposits	- If finish too smooth, resurfacing required to provide texture - Wire broom to remove curing membrane - Grooving - Remove rubber.

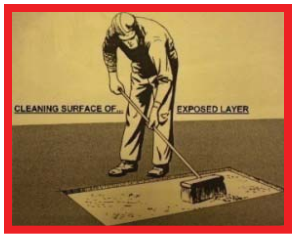
FIELD WORK FOR AC

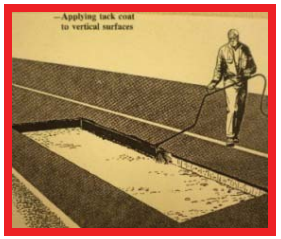
- PARTIAL PATCH
- DEEP PATCH

DEEP PATCH / PARTIAL PATCH REPAIR IN AC PAVEMENT









Permanent Solution

(DEEP PATCH)

REPAIR SOLUTIONS (?)

Temporary Solution

(PARTIAL PATCH)

PARTIAL PATCH/ DEEP PATCH

(Temporary / Permanent)

AC REPAIR

PARTIAL PATCH

(Temporary Repair)

REPAIR PROCEDURE for ALLIGATOR CRACKING:

(**PARTIAL PATCH**, TEMPORARY/ REMOVE, AND REPLACE)

- Locate the affected area

- Use a blower or broom to remove the dirt & FOD

- Apply a thin layer of tack-coat

NOTE:

Repairs should be made ASAP to avoid further damage to the pavement and to protect the aircrafts from ingesting the FOD.

REPAIR PROCEDURE for ALLIGATOR CRACKING:

(**PARTIAL PATCH**, TEMPORARY/ REMOVE, AND REPLACE)

- Fill the area with suitable materials

- The field materials should cover a minimum of 2-3 inches wider in diameter compared to the original affected area in order to seal the borders of the affected area

- Use the appropriate tools to distribute the materials to the same level of the surrounding area

REPAIR PROCEDURE for ALLIGATOR CRACKING:

(**PARTIAL PATCH**, TEMPORARY/ REMOVE, AND REPLACE)

- Remove all of the unattached asphalt materials prior to compaction

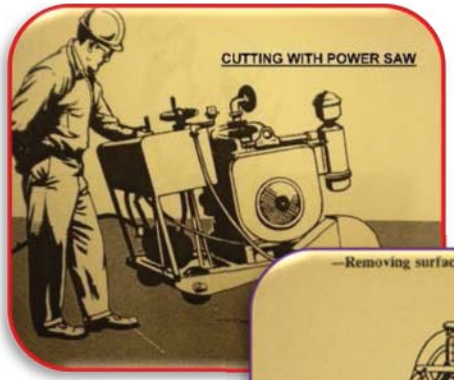
- Use the right tools to compact the partial patch area

- Use the straightedge to make sure that the patch surface is even with the existing surface pavement

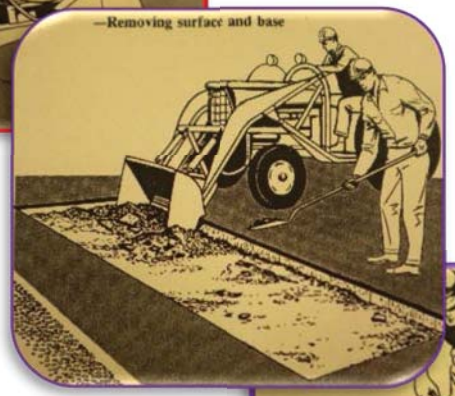
REPAIR PROCEDURE for ALLIGATOR CRACKING:

(DEEP PATCH, PERMANENT REPAIR/ SAW CUT, REMOVE, AND REPLACE)

- Locate the affected area



- Saw cut the defected area with a power saw. Remove the surface as deep as necessary to reach firm support. Extend at least a foot into good pavement outside the cracked area.



- Make the cut square or rectangular with faces straight and vertical. One pair of faces should be at right angles to the direction of traffic

- Depending on the level of deterioration, some material from the base course and sub-grade may also have to be removed.

REPAIR PROCEDURE for ALLIGATOR CRACKING:

(DEEP PATCH, PERMANENT REPAIR/ SAW CUT, REMOVE, AND REPLACE)

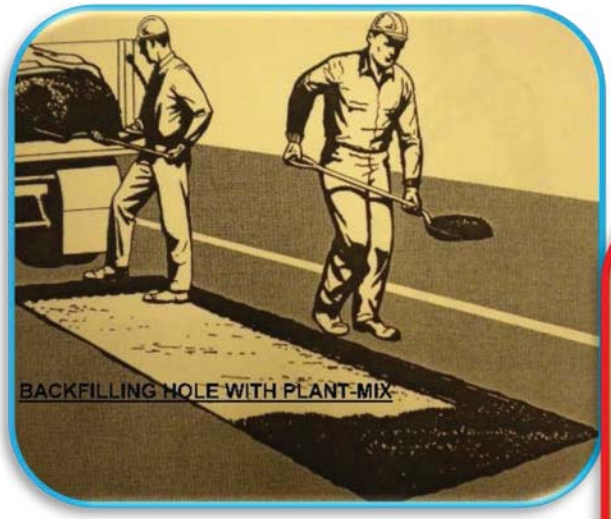
Apply a tack coat to the vertical faces …

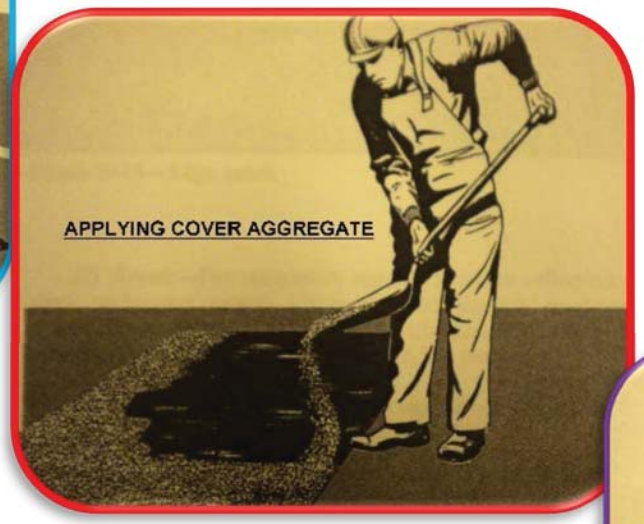
…as well as an application of tack or prime coat to protect the base course.

For best results, backfill the hole with a dense-graded hot asphalt plant-mix.

REPAIR PROCEDURE for ALLIGATOR CRACKING:

(DEEP PATCH, PERMANENT REPAIR/ SAW CUT, REMOVE, AND REPLACE)

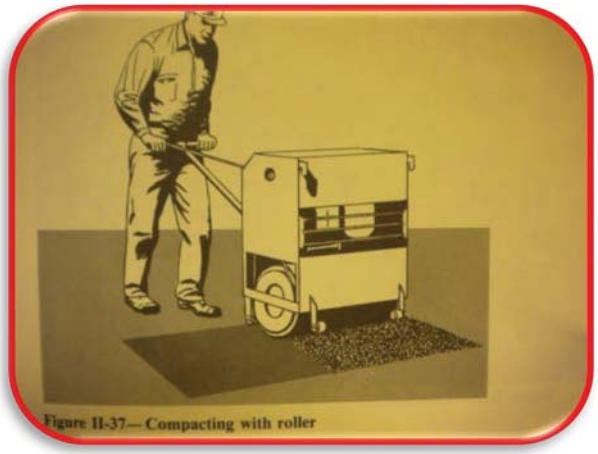




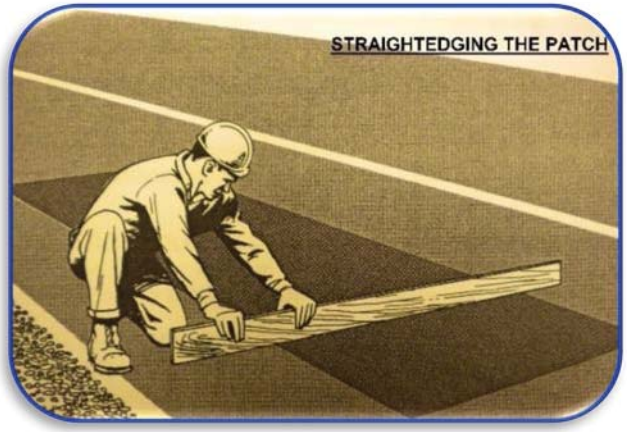
Fill and spread the asphalt carefully to prevent segregation of the mixture.

REPAIR PROCEDURE for ALLIGATOR CRACKING:

(DEEP PATCH, PERMANENT REPAIR/ SAW CUT, REMOVE, AND REPLACE)



- A vibratory plate compactor is good for small patches but a roller may be more practical for larger areas.



- Use the straightedge to check the alignment of the patch to ensure the appropriate riding condition.

REPAIR PROCEDURE for BLEEDING:

(**OPTIONAL ALTERNATIVE,** Source: Asphalt Institute)

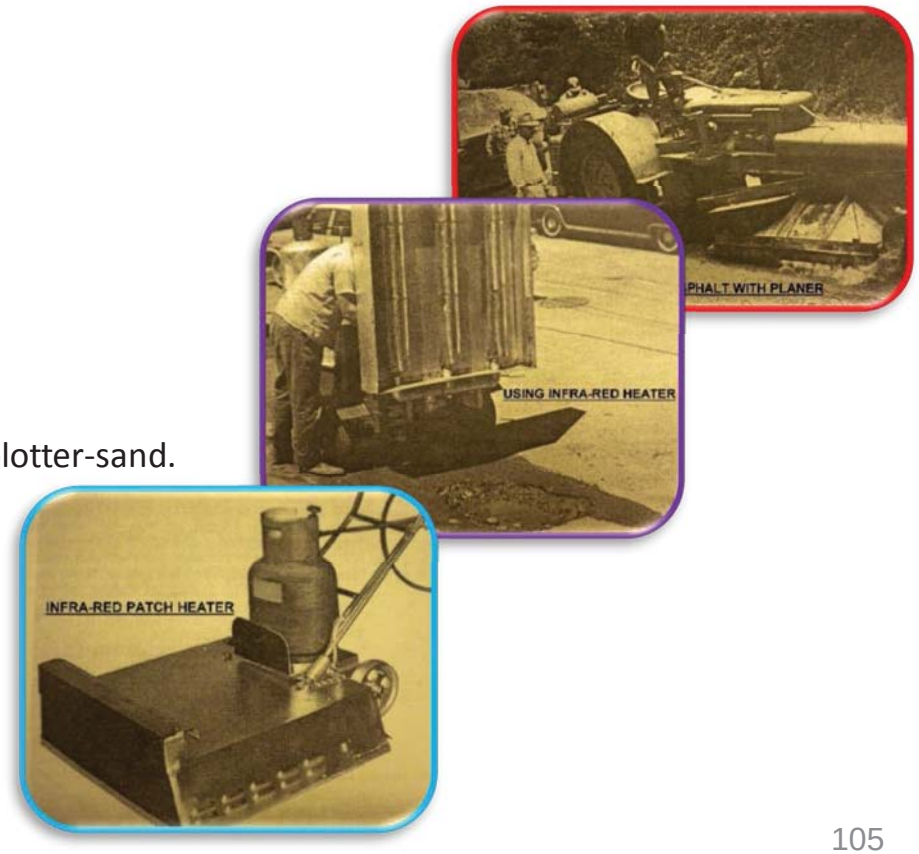
For minor bleeding:

- a pavement milling or grinding machine may be used to remove the excess asphalt by milling off 1/8 inch to 1/4 inch of pavement.

Prior to milling or grinding, the use of infra-red heaters to soften the HMA pavement surface should be used. After heating of the pavement surface:

- scrape the asphalt binder from the surface,
- apply blotter-sand,
- roll with a steel-drum roller,
- remove any excess blotter-sand from the surface.

Repeat the process if bleeding re-occurs through the blotter-sand.



FAA:
R/P:
- Scrap surface and blotter-sand-roll (blotter-sand)
- Mill and repave (FAA P- 401)

FIELD WORK FOR PCC

- FULL- DEPTH REPAIR
- PARTIAL-DEPTH REPAIR

REPAIR PROCEDURE for CORRUGATION:

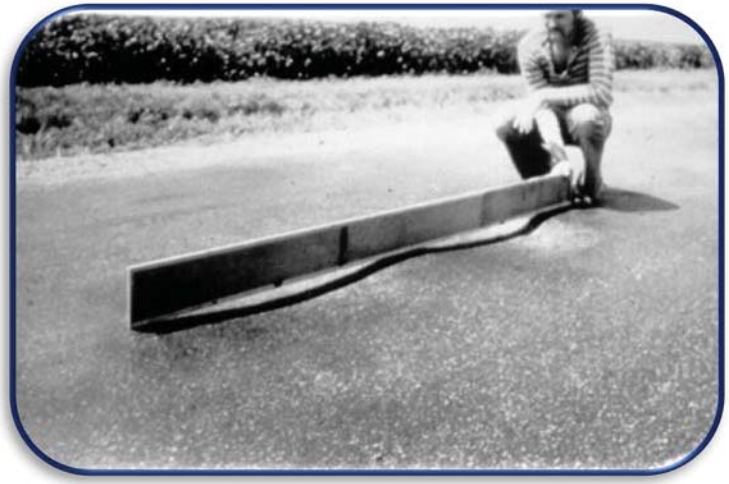
(**OPTIONAL ALTERNATIVE,** Source: Asphalt Institute)

Temporary:
If the corrugated pavement has an aggregate base with a thin surface treatment, a satisfactory corrective measure is:

- scarify the surface,
- mix it with the base, and
- re-compact the mixture before resurfacing.

If the pavement has more than 2” of asphalt surfacing and base:

- remove with a pavement planning machine.
- follow with a seal coat or plant-mixed surface.



Permanently:
For effective repair, shoved areas must be removed and patched.

FAA:
R/P : - Saw cut area, remove and replace
(State DOT modified surface mix)
(FAA P 401)

T/E : - Slurry seal (emulsified asphalt)
- Seal coat (coal-tar pitch emulsion

FULL- DEPTH REPAIR

(BLOWUP, PATCHING, D-CRACKING, CORNER BREAK, SCALING-MAP CRACKING)

General distress criteria for placement of full-depth repairs of JCP.

DISTRESS TYPE	SEVERITY LEVEL REQUIRED FOR FULL-DEPTH REPAIR
Blowup	L, M, H
Corner Break	L, M, H
Durability D-Cracking	M[1], H
Deterioration Adjacent to Existing Repair	M[1], H
Deterioration of Existing Repairs	M[1], H
Spalling of Joints	M[1], H
Spalling of Cracks	M[2], H
Reactive Aggregate Spalling	M[1], H
Deteriorated Crack in AC Overlay	M[1], H

NOTE: Traffic level will affect repair requirements. For example, highways with low traffic levels may not require repair at the recommended severity level.

[1]These distress types may only require partial-depth repair if they are limited to the upper half of the pavement slab.

[2]An alternative repair method is load transfer restoration.

FULL-DEPTH REPAIR FOR PCC

(BLOWUP, CORNER BREAK, SCALING-MAP CRACKING and JOINT or CRACK SPALLING)

Full-depth repairs are necessary when slabs have been shattered or have deteriorated to the point that the safety for the support of the load is no longer sufficient. Full-depth patch repair of PCC pavements is a rehabilitation method that involves the removal of an entire slab or a partial portion of the entire slab, the installation of load transfer devices, and the replacement of PCC material.

- **PROCEDURES FOR REPAIRING CORNER BREAKS**
- **FULL DEPTH SLAB REPAIR DETAIL**
- **DOWEL & TIEBAR PLACEMENT**
- **PROCEDURES FOR REPAIRING BLOW-UP**
- **PROCEDURES FOR REPAIRING PUMPING**
- **REPAIR FOR TRANSVERSE CRACKING**

PROCEDURES FOR REPAIRING CORNER BREAKS

These are considered structural failures and require full-depth repairs. The procedures for repairing these types of distresses are as follows:

(1) Make full-depth saw cuts at constructed joints. The full-depth cuts should be made at a distance of at least 2 feet beyond the limits of the break. Make the saw cuts so the repair area is rectangular. For corner cracks, cut the repair area square.

(2) Use appropriate-sized impact equipment (e.g., jackhammer) to remove material within the limits of the saw cuts. Make a second saw cut inside the perimeter cuts to provide expansion. Remove by hand any loose materials that remain. During the repair, try to minimize any disturbance to the sub-grade soils or base materials.

(3) Restore sub-grade or sub-base materials if needed.

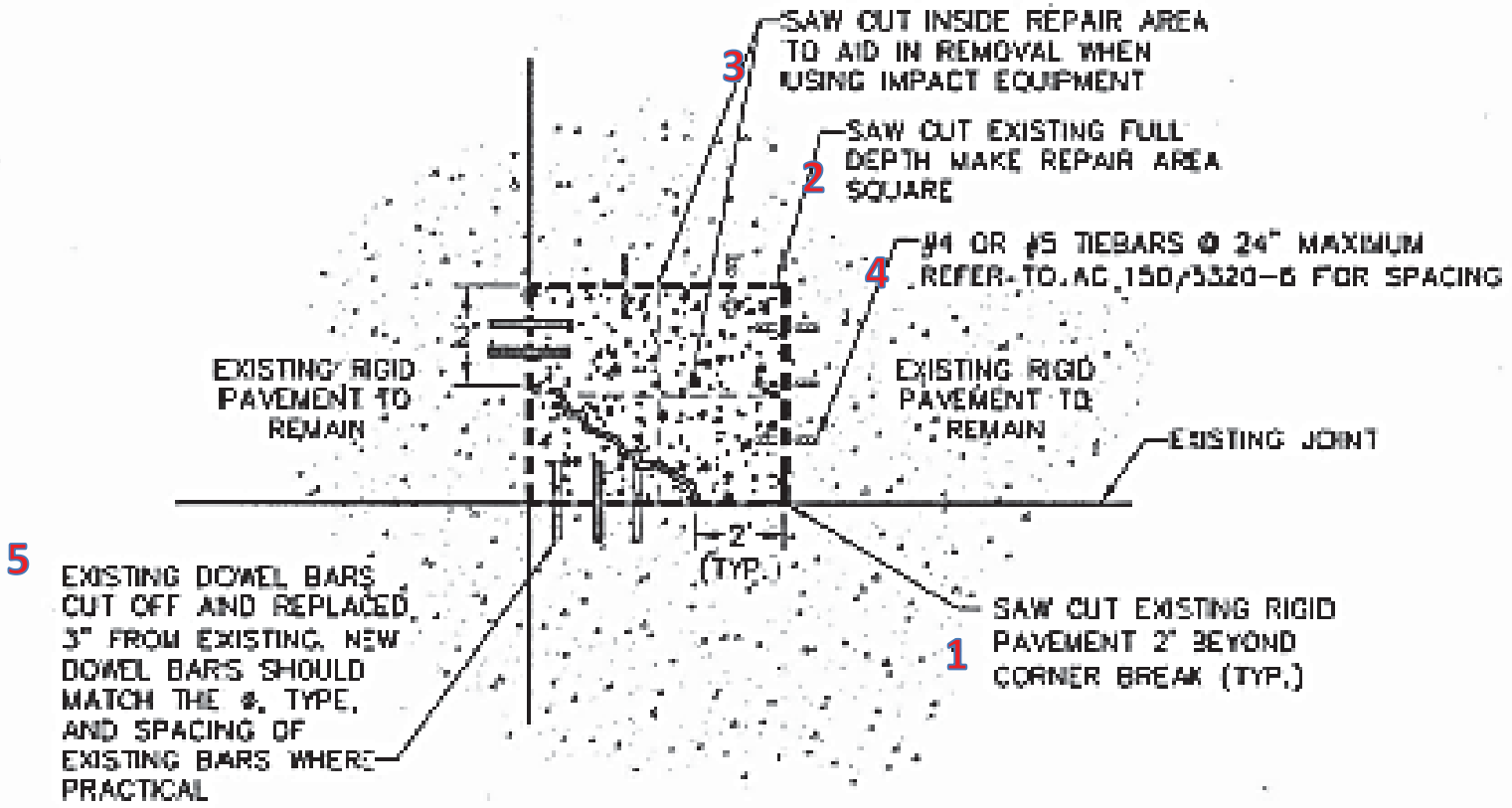
(4) Use #4 tie-bars for pavements < 12" and #5 tie-bar for pavements >12" thick in the faces of the parent panel. Install by drilling into the face and using an epoxy bonding agent. Use equal distance spacing for the bars with **< 24"** apart.

(5) Use dowel bars, of the type and size of the existing dowel bars, in the joint that parallels the direction of traffic. Dowels are installed by drilling and epoxying.

(7) Fill 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, particularly during consolidation, and watch for segregation of the concrete. Finish the surface to match existing surface when practical.

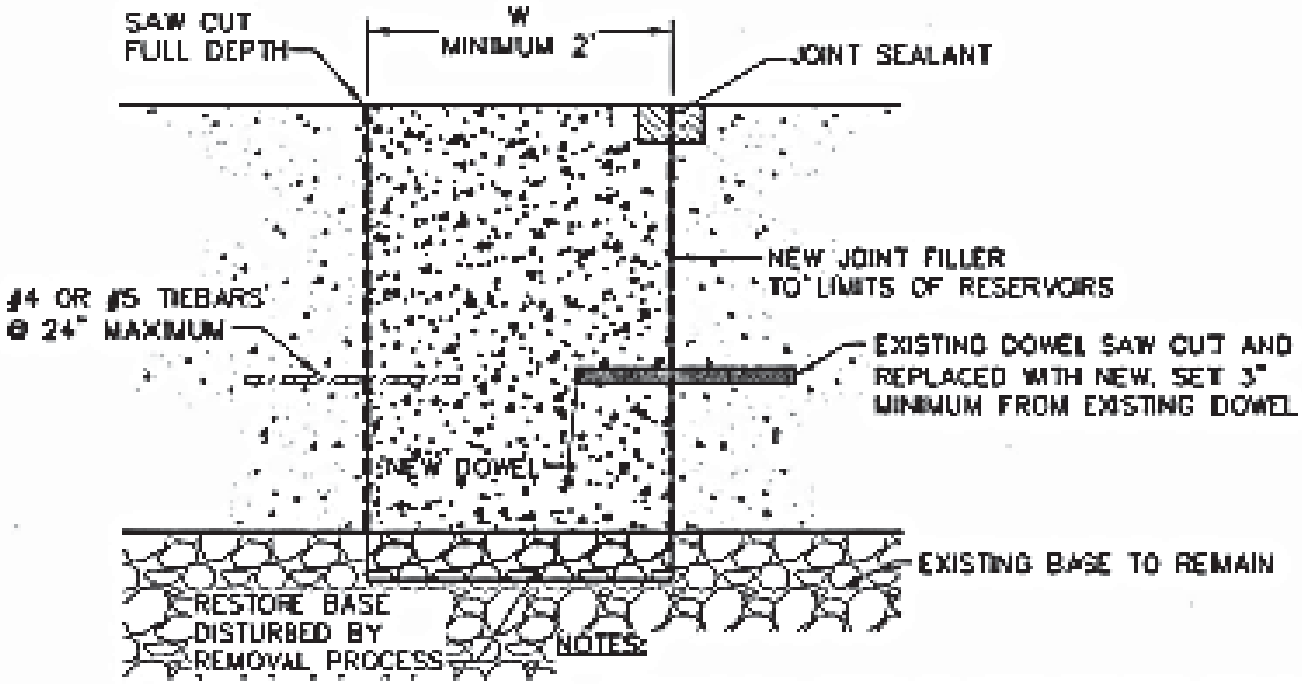
(8) Reinstall joint seal.

CORNER BREAK Repair (1)



SOURCE: FAA

CORNER BREAK REPAIR (2)

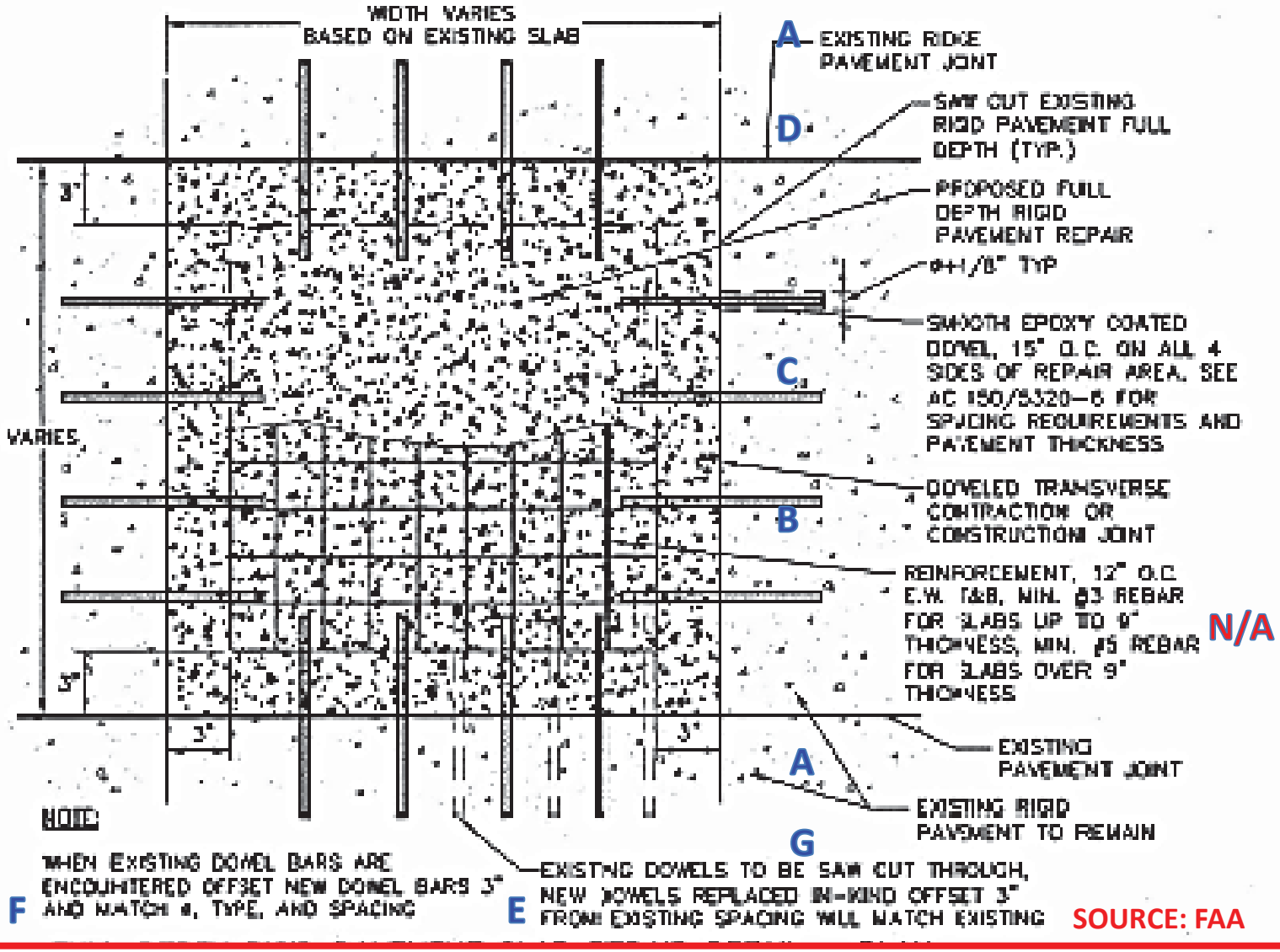


CORNER BREAK REPAIR DETAIL – SECTION

NOT TO SCALE
FIGURE C-2

SOURCE: FAA

FULL DEPTH RIGID PAVEMENT SLAB REPAIR DETAIL-PLAN



SOURCE: FAA

DOWEL & TIEBAR PLACEMENT

The purpose of tiebars and dowel bars are to maintain the alignment of the pavement slabs and to properly transfer the load between the slabs respectively.

In repair of jointed concrete pavement, replacing the dowel bars appears to be the most critical factor affecting the full-depth repair performance.

Dowels provide load transfer across repair joints while at the same time allowing the joint to open and close as the surrounding pavement expands and contracts in response to temperature and moisture changes.

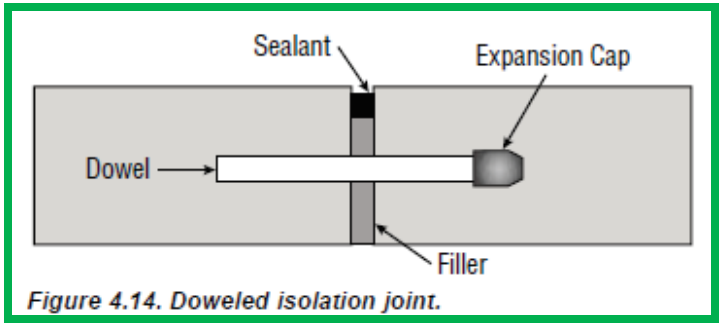


Figure 4.14. Doweled isolation joint.

Dowels used at expansion joints should be capped at one end to prevent further penetration of the dowels into the concrete when the joints close.


Patch area compaction.


Figure 4.11. Smooth steel dowels and deformed tiebars.

PROCEDURES FOR REPAIRING BLOW-UP

a. Remove the damaged portion of the slab by sawing the straight, neat cut with a pavement saw.

b. Level the sub-base, if required, and prime it.

c. Apply tack coat to the sides of the slab **(A)**

d. Place and compact dense-graded asphalt concrete in layers not exceeding 4” each. If the area is not large enough for a full size roller, mechanical rammers and/or vibrating plate compactors should be used.

e. The surface should be finished flush with surrounding pavement.

PROCEDURES FOR REPAIRING PUMPING

(SLABJACKING)

PURPOSE:

The purpose of slab-jacking is to raise a slab in place permanently in order to prevent impact loading, correct faulty drainage, and prevent pumping at transverse joints by injection of a grout under the slab.

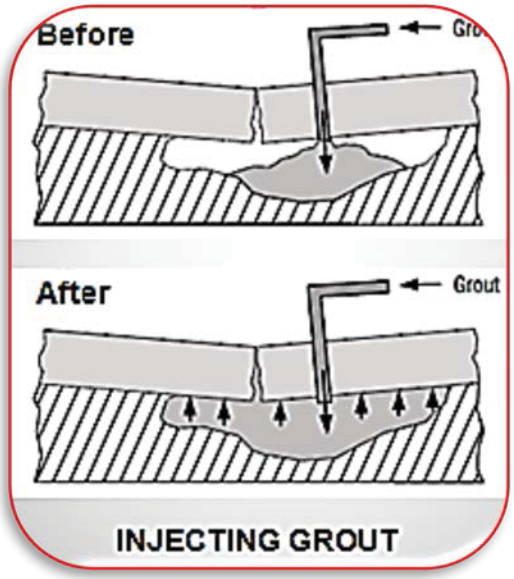
Slab-jacking should be considered for any condition that causes non-uniform slab support

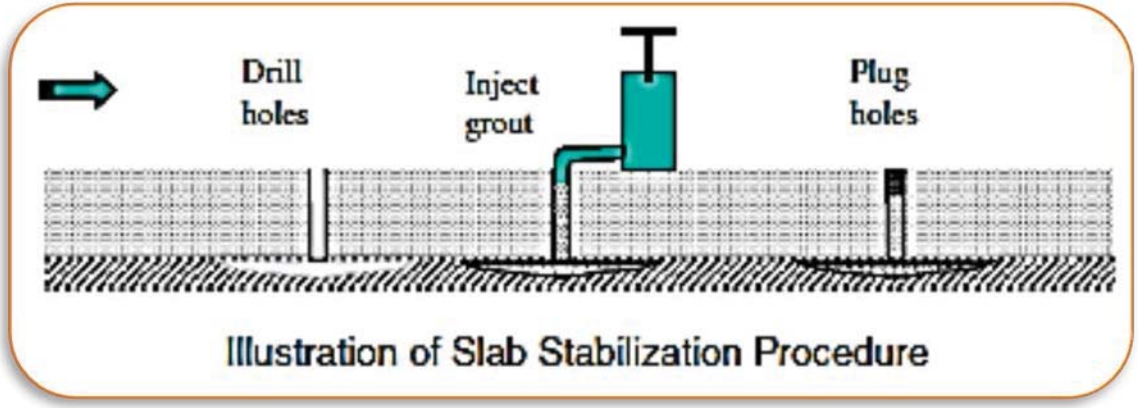
LOCATION OF INJECTION HOLES:

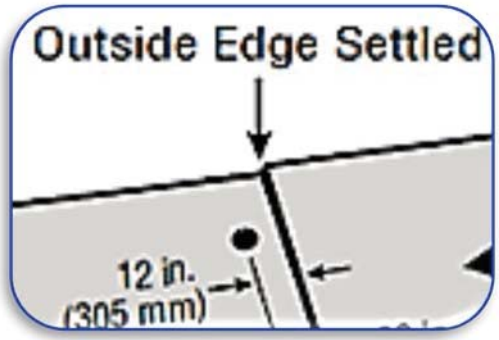
As a general rule, holes should not be placed less than 12" or more than 18" from a transverse joint or slab edge.

DRILLING HOLES:

Holes are 1.25 to 2" in diameter. Drill or core must be capable of injecting grout through the concrete pavement and the base material.







SOURCE: **American Concrete Association**

REPAIR FOR TRANSVERSE CRACKING

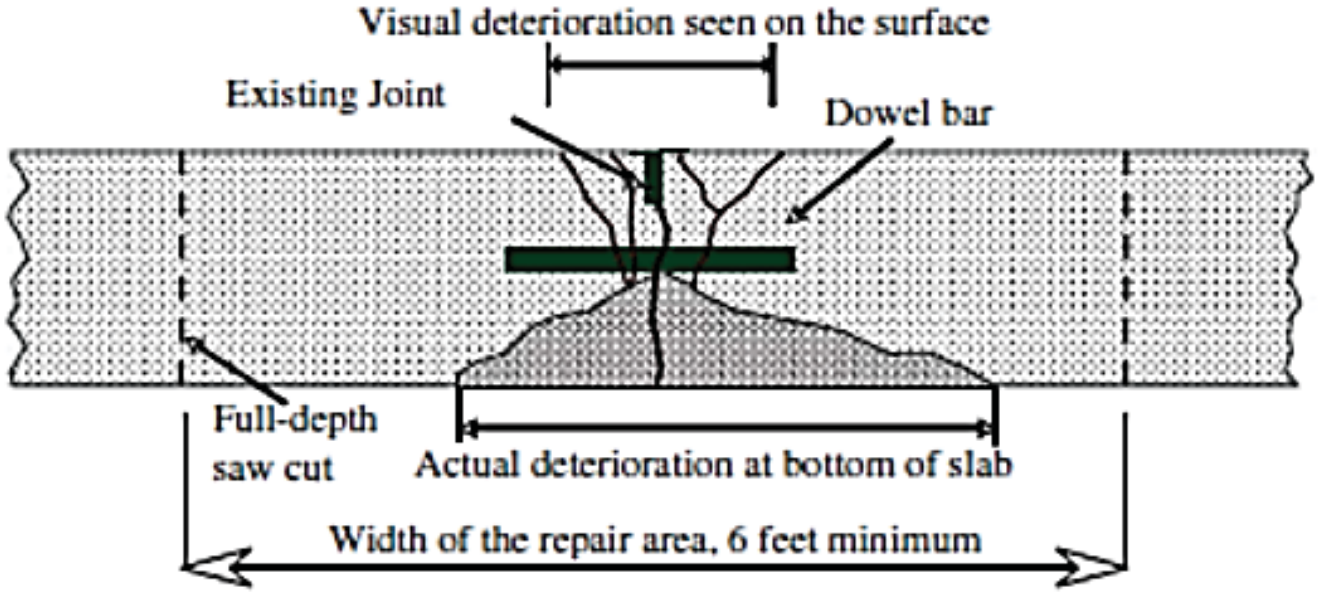
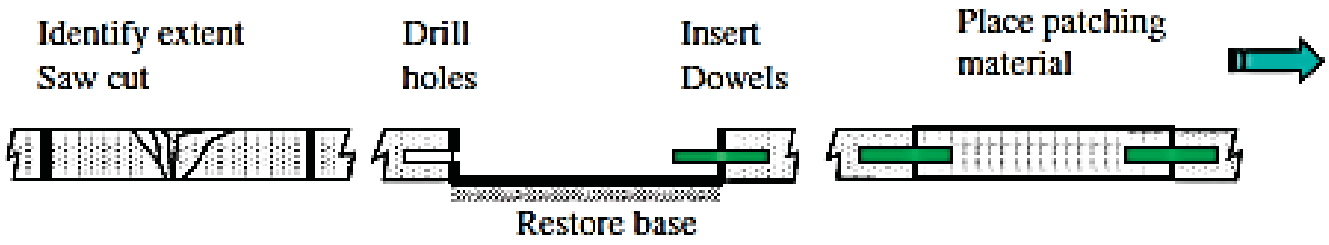


FIGURE B12 Cross section of deteriorated transverse joint.



Sequence of Operation of Full-depth Repair of PCC Pavements

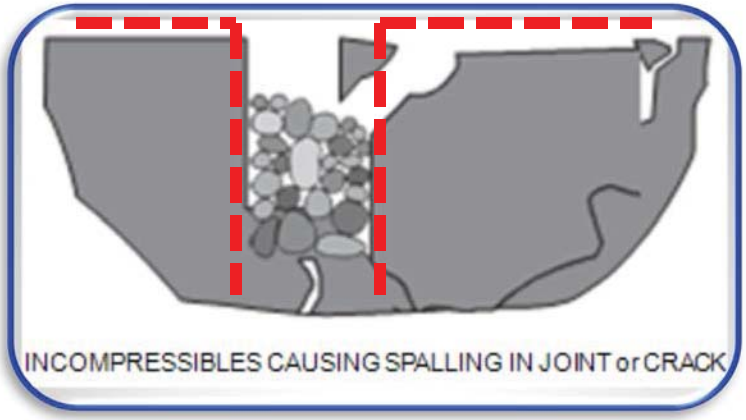
PARTIAL- DEPTH REPAIR

(JOINT/CRACKS SEALING AND SPALL REPAIR)

PURPOSE:

Partial-depth repair is typically used to repair spalling either at joints or at mid-slab locations. The purpose of partial-depth repair for the PCC pavement is to correct localized areas of concrete pavement distress.

Repair of this type restores ride ability, deters further deterioration, reduces foreign object damage potential, and provides proper edges so that joints can be effectively resealed.



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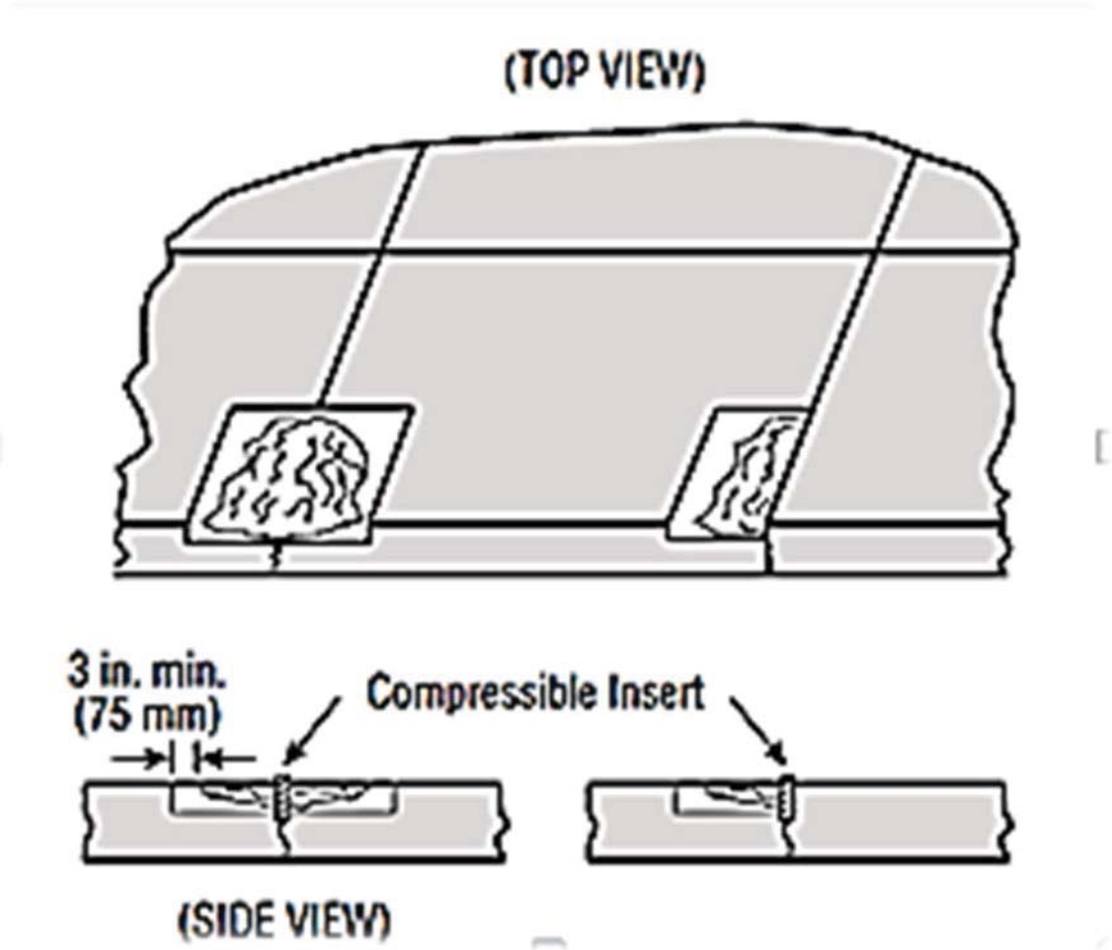
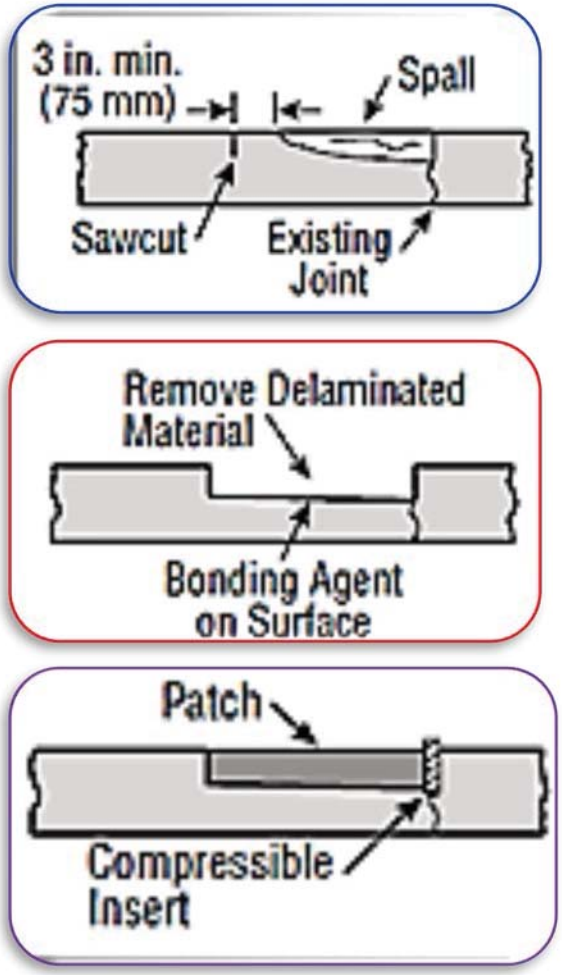
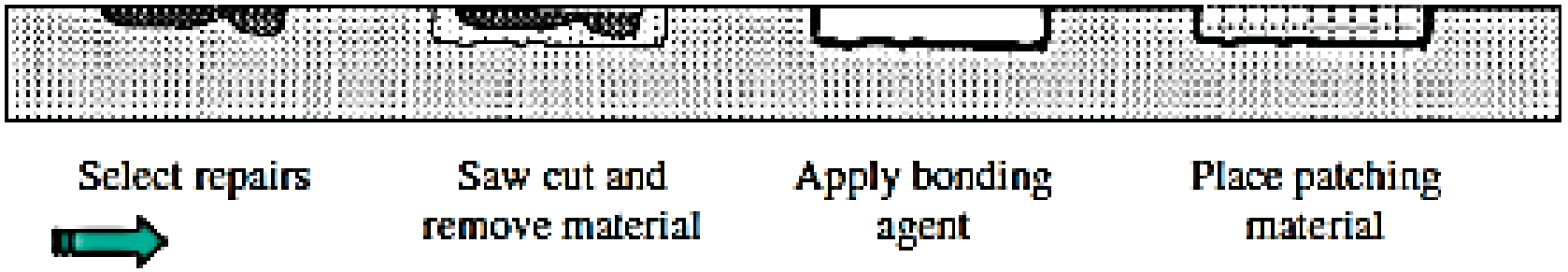
- PARTIAL-DEPTH REPAIR PROCESS
- PROCEDURES FOR REPAIRING JOINT SPALLING
- PROCEDURES FOR POPOUTS
- SEALING OF JOINTS & CRACKS

PARTIAL-DEPTH REPAIR





PARTIAL-DEPTH REPAIR PROCESS



Construction Steps of Partial-depth Repair of PCC Pavement

Partial-depth patch repair of PCC pavements is a maintenance activity that includes:

- select repair area
- saw cut and removal of damaged material from affected areas,
- apply bonding agent
- replacing it with new PCC material or AC material.

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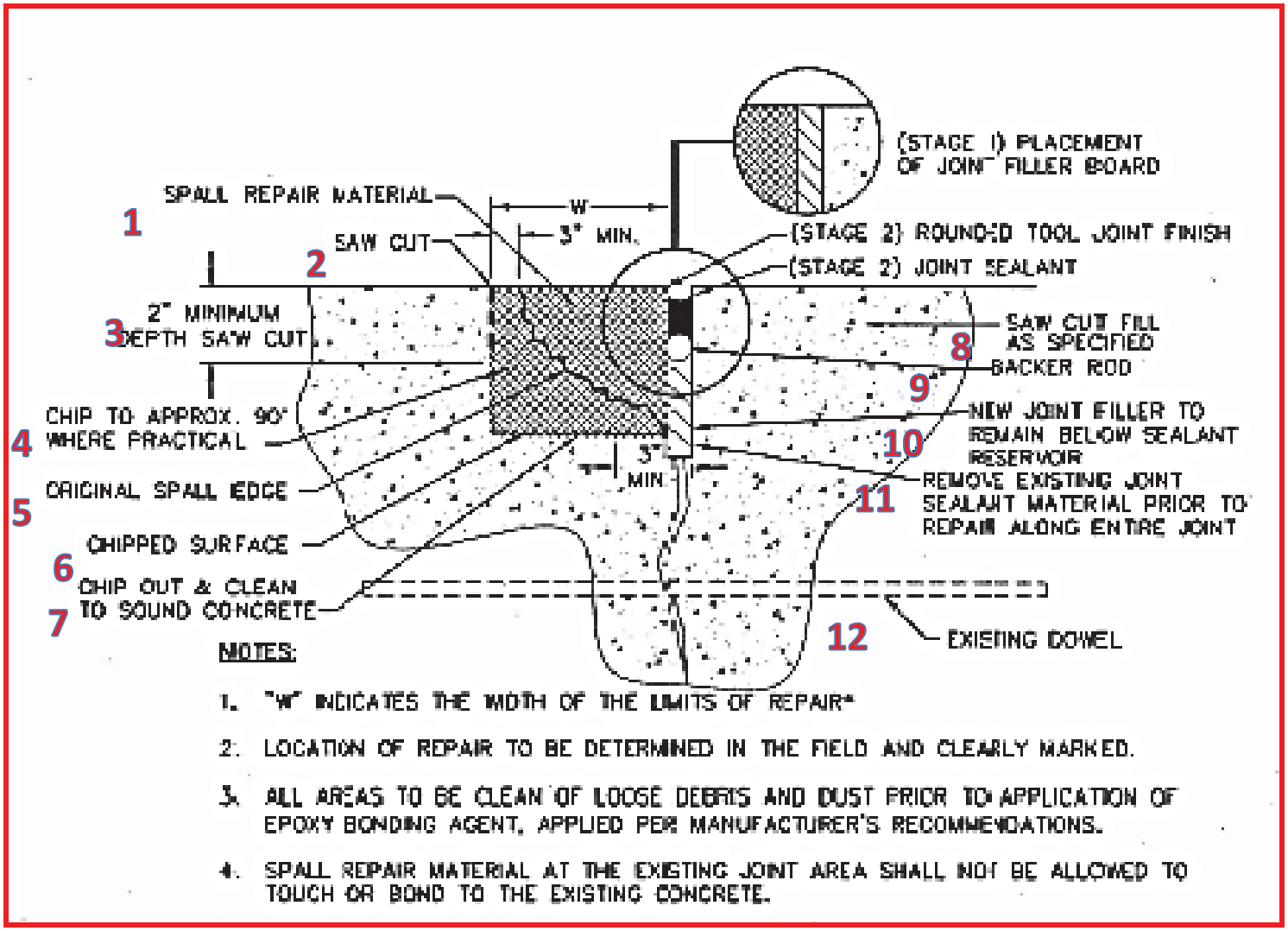
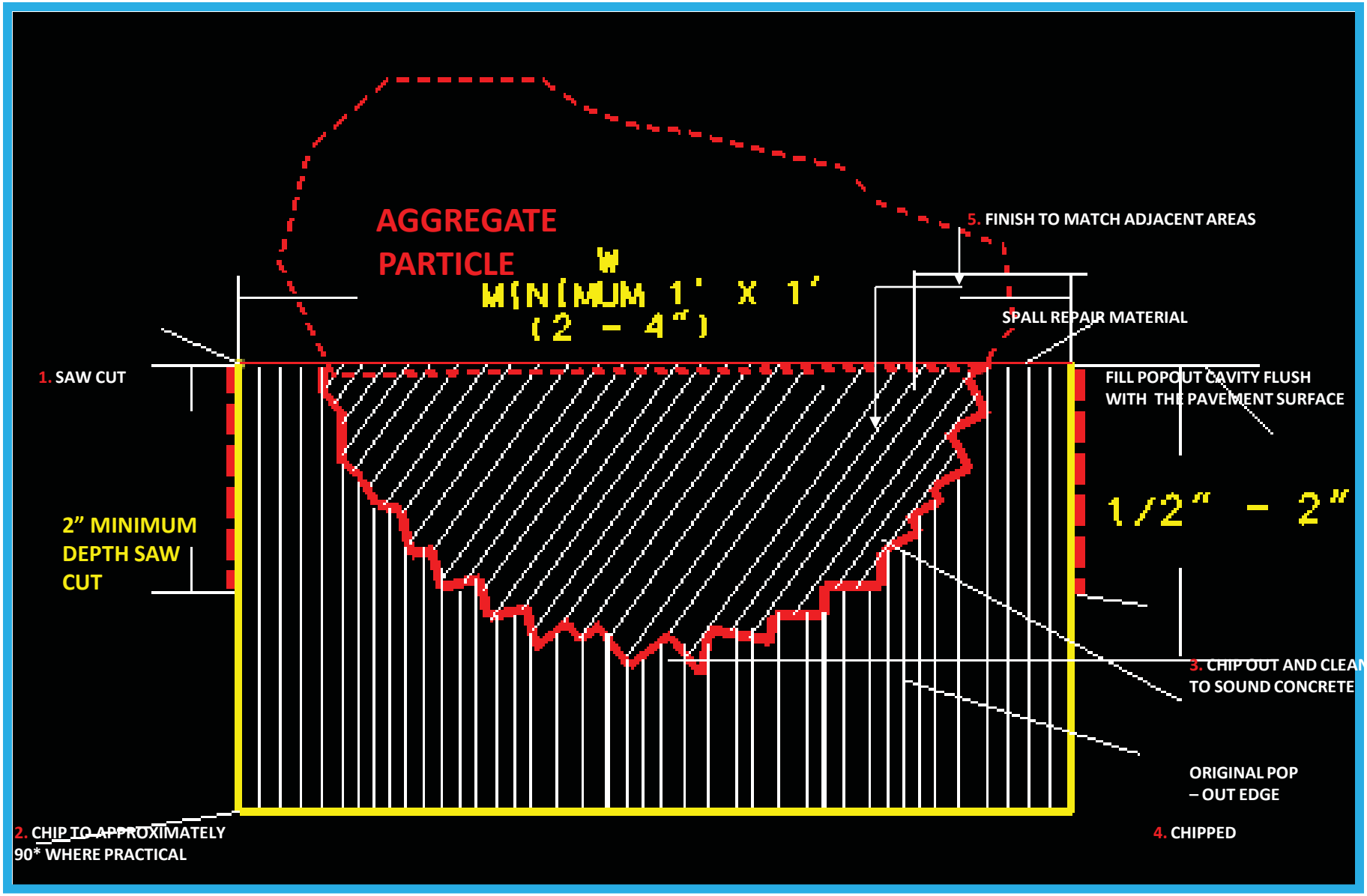
PROCEDURES FOR REPAIRING JOINT SPALLING



SOURCE: FAA

PROCEDURES FOR POPOUT

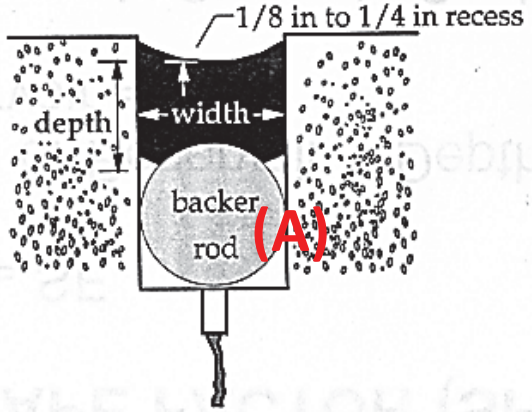


TYPICAL POPOUT SPALL REPAIR DETAIL (NTS)

SEALING OF JOINTS & CRACKS

Sequence of Sealing Joints and Cracks in PCC Pavements

Sealing of joints and cracks in PCC pavements is a maintenance treatment that re-seals joints that have missing or poorly performing sealants, and seals major cracks.



METHODS OF REPAIR

GENERAL: This chapter describes various methods airports can use to correct airfield pavement distress.

While these repair methods apply to specific types of distress and pavements, they should all take into account the possibility of foreign object damage (FOD) to aircraft. Untidy repair activities may leave potential FOD at or near the repair sites. Improperly constructed repairs may disintegrate and cause a FOD potential. All maintenance activities must include quality control monitoring to assure that repairs are conducted properly and clean-up activities undertaken to remove this potential. The current version of AC 150/5380-5, *Debris Hazards at Civil Airports,* provides additional guidance to help eliminate debris hazards associated with maintenance activities.

a. Visible evidence of excessive stress levels or environmental distress in pavement systems may include cracks, depressions, and other types of pavement distresses. The formation of distresses in airport pavements may severely affect the structural integrity; ride quality, and safety of airport pavements. To alleviate the effects of distresses and to improve the airport pavement serviceability, airports should adopt an effective and timely maintenance program and adequate repair procedures.

b. In all cases of pavement distress, the first step in rehabilitating a pavement is to determine the causes of distress. Then, the proper procedures for repair—which will not only correct the damage, but also prevent or retard its further occurrence—may be applied. Pavement repairs should be made as quickly as possible after the need for them arises to ensure continued and safe aircraft operations. Airports should perform repairs at early stages of distress, even when the distresses are considered minor. A delay in repairing pavements may allow minor distresses to progress into major failures. While deterioration of pavements due to traffic and adverse weather conditions cannot be completely prevented maintenance and repair programs can significantly reduce the rate of deterioration and minimize the damage.

c. Weather conditions may limit repair measures undertaken to prevent further pavement damage. For example, rehabilitation by crack filling is more effective in cool and dry weather conditions, whereas pothole patches, seal coats, and other surface treatments require warm, dry weather for best results. This does not mean that resurfacing work cannot be performed under cold and damp conditions or that crack filling cannot be done in warm weather. Rather, these repairs just require much greater care when made during such periods.

d. The minimum depth of repair for Portland cement concrete should be 2 inches (5 cm). Repairs made thinner than 2 inches (5 cm) usually deteriorate quickly on an airfield pavement. (Most distresses needing repair will extend at least 2 inches (5 cm) into the pavement.) Concrete pavement repairs which are thinner than 2 inches (5 cm) may benefit from the use of epoxy materials.

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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**: Narrow cracks, less than 1/4 inch (6 mm), are too small to seal effectively. In areas where narrow cracks are present, a seal coat, slurry seal, or fog coat may be applied. Sawing or routing can also widen narrow cracks. Wide cracks, greater than 1/4 inch (6 mm), should be sealed using the following procedure:

a. 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.
b. Fill cracks with a prepared crack sealer.

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

a. 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.
b. 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.
c. Apply a tack coat to the vertical faces of the existing pavement.
d. Place bituminous concrete and compact.
e. 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:
   a. 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.
   b. Clean the surface of the exposed underlying layer with brooms and compressed air.
   c. Apply a light tack coat.
   d. 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.
   e. Compact the asphalt mixture with steel-wheel or rubber-tire rollers until the surface is the same elevation as the surrounding pavement.
4. **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:
   a. Sweep the surface free of all dirt and loose aggregate material.
   b. Apply the surface treatment.
   c. Close to traffic until the seal has cured.
5. **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.
6. **Rutting**: The repair procedures are as follows:
   a. Determine the severity of the rutting with a straightedge or stringline. Outline the areas to be corrected on the pavement surface

b. Mill or grind down the identified area to provide a vertical face around the edge. The FAA recommends a minimum patch depth of 2 inches (5 cm).
c. Thoroughly clean the entire area.
d. Apply a light tack coat of asphalt emulsion to the area to receive asphalt material, including the vertical face of the patch area.
e. 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.
f. Thoroughly compact the asphalt patch material with a roller or vibratory plate compactor.

7. Corrugation and Shoving: The repair procedure for this type of distress is the same as for patch repair of alligator cracking.

8. **Depressions**: The repair procedures are as follows:

a. Determine the limits of the depression with a straightedge or stringline. Outline the depression on the pavement surface.
b. Mill or grind down the area to provide a vertical face around the edge. The FAA recommends a minimum patch depth of 2 inches (5 cm).
c. Thoroughly clean the entire area to be repaired.
d. a light tack coat of asphalt emulsion to the area to receive asphalt material, including the vertical Apply ace of the patch area.
e. 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.
f. 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.

g. Thoroughly compact the patch with a roller or vibratory-plate compactor.
h. Swelling. The repair procedure is the same as for patch repair of alligator cracking.

9. **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.

10. **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:

a. 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).
b. Immediately after spreading, roll with a rubber-tired roller.
c. When the aggregate has cooled, broom off loose particles.
d. Repeat the process if necessary.

11. **Polished Aggregate**: One means of correcting this condition is to cover the surface with an aggregate seal coat. Grooving, milling, or diamond grinding the pavement surface are also useful techniques.

12. **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.

13. **Contaminants**: Rubber deposits may be removed by use of high-pressure water or biodegradable chemicals.

REPAIR METHODS FOR PORTLAND CEMENT CONCRETE 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:

   a. 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. The FAA does not recommend widths smaller than 3/8 inches (10 mm) because such widths are difficult to fill with sealant material.
   b. 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.
   c. 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. Improper bonding restricts the expansion and contraction of the sealant material and can cause premature failure. Backer rod is commonly used to prevent bonding and to establish the proper joint reservoir dimensions. Backer rod is an extruded, chemically inert; closed-cell polyethylene "rope" designed to effectively fill in the gaps in the joint. The backer rod is sized slightly larger than the width of the joint and is simply pushed to the desired depth.
   d. 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.

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:

a. Make full-depth saw cuts at constructed joints. The FAA recommends that full-depth cuts be made at a distance of at least 2 feet (60 cm) beyond the limits of the crack. 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.
b. Use a jackhammer to remove material within the limits of the saw cuts. When using a tractor mounted hammer or removing the concrete by lifting, make a second saw cut inside the perimeter cuts to provide expansion.
   Remove by hand any loose materials that remain. During the repair, try to minimize any disturbance to the subgrade soils or base materials.
c. Restore subgrade or subbase materials to the base elevation of the panel being repaired.
d. 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. When spacing bars, do not allow their ends to overlap with those of other tie-bars or dowels.
e. 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. Space dowel bar ends at least one bar spacing apart at corners of intersecting joints. Oil exposed dowel bar ends prior to backfilling with concrete.
f. 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.

g. 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.
h. 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. Temporary repairs can be made using the technique noted in paragraph 13.

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

b. When changing the material type of the joint seal, the FAA recommends removing old material from the reservoir by re-facing the sidewalls. Re-facing will result in a change to the reservoir shape factor (width to depth ratio). Consult the manufacturer of the replacement joint seal material about the recommended shape factor. If a saw is used to reface the joint, flush the joint with water immediately after sawing. Remove any remaining debris by sand blasting each face of the joint reservoir.
c. If the same material will be used to replace the existing joint seal, clean the reservoir with high-pressure water or sand blasting.
d. Immediately prior to sealing, blow out the joint with clean, oil-free compressed air to remove sand, dirt, and dust.
e. Install new dry backer rod.
f. Seal joints with hot or cold compounds. Sealants should be placed as noted in paragraph 13.

c. Weather conditions may limit repair measures undertaken to prevent further pavement damage. For example, rehabilitation by crack filling is more effective in cool and dry weather conditions, whereas pothole patches, seal coats, and other surface treatments require warm, dry weather for best results. This does not mean that resurfacing work cannot be performed under cold and damp conditions or that crack filling cannot be done in warm weather. Rather, these repairs just require much greater care when made during such periods.

d. The minimum depth of repair for Portland cement concrete should be 2 inches (5 cm). Repairs made thinner than 2 inches (5 cm) usually deteriorate quickly on an airfield pavement. (Most distresses needing repair will extend at least 2 inches (5 cm) into the pavement.) Concrete pavement repairs which are thinner than 2 inches (5 cm) may benefit from the use of epoxy materials.

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**: Narrow cracks, less than 1/4 inch (6 mm), are too small to seal effectively. In areas where narrow cracks are present, a seal coat, slurry seal, or fog coat may be applied. Sawing or routing can also widen narrow cracks. Wide cracks, greater than 1/4 inch (6 mm), should be sealed using the following procedure:

a. 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.

b. Fill cracks with a prepared crack sealer.

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

   a. 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.

   b. 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.

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

   d. Place bituminous concrete and compact.

   e. 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:

   a. 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.

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

   c. Apply a light tack coat.

d. 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.

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

4. **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:

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

b. Apply the surface treatment.

c. Close to traffic until the seal has cured.

5. **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.

6. **Rutting**: The repair procedures are as follows:

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

b. Mill or grind down the identified area to provide a vertical face around the edge. The FAA recommends a minimum patch depth of 2 inches (5 cm).

c. Thoroughly clean the entire area.

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

e. 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.

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

7. **Corrugation and Shoving**: The repair procedure for this type of distress is the same as for patch repair of alligator cracking.

8. **Depressions**: The repair procedures are as follows:

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

b. Mill or grind down the area to provide a vertical face around the edge. The FAA recommends a minimum patch depth of 2 inches (5 cm).

c. Thoroughly clean the entire area to be repaired.

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

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

f. 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.

g. 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.

9. **<u>Loss of Skid Resistance</u>**: Treatment for loss of skid resistance includes removal of excess asphalt, resurfacing, grooving to improve surface drainage, and removing of rubber deposits.

10. **<u>Bleeding</u>**: 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:

a. 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).

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

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

d. Repeat the process if necessary.

11. **Polished Aggregate**: One means of correcting this condition is to cover the surface with an aggregate seal coat. Grooving, milling, or diamond grinding the pavement surface are also useful techniques.

12. **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.

13. **Contaminants**: Rubber deposits may be removed by use of high-pressure water or biodegradable chemicals.

REPAIR METHODS FOR PORTLAND CEMENT CONCRETE 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:
   a. 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. The FAA does not recommend widths smaller than 3/8 inches (10 mm) because such widths are difficult to fill with sealant material.

   b. 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.

   c. 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. Improper bonding restricts the expansion and contraction of the sealant material and can cause premature failure. Backer rod is commonly used to prevent bonding and to establish the proper joint reservoir dimensions. Backer rod is an extruded, chemically inert; closed-cell polyethylene "rope" designed to effectively fill in the gaps in the joint. The backer rod is sized slightly larger than the width of the joint and is simply pushed to the desired depth.

   d. 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:

   a. Make full-depth saw cuts at constructed joints. The FAA recommends that full-depth cuts be made at a distance of at least 2 feet (60 cm) beyond the limits of the crack. 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.

   b. Use a jackhammer to remove material within the limits of the saw cuts. When using a tractor mounted hammer or removing the concrete by lifting, make a second saw cut inside the perimeter cuts to provide expansion. Remove by hand any loose materials that remain. During the repair, try to minimize any disturbance to the subgrade soils or base materials.

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

   d. 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. When spacing bars, do not allow their ends to overlap with those of other tie-bars or dowels.

   e. 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. Space dowel bar ends at least one bar spacing apart at corners of intersecting joints. Oil exposed dowel bar ends prior to backfilling with concrete.

f. 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.

g. 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.

h. 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. Temporary repairs can be made using the technique noted in paragraph 13.

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

a. 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.

b. When changing the material type of the joint seal, the FAA recommends removing old material from the reservoir by re-facing the sidewalls. Re-facing will result in a change to the reservoir shape factor (width to depth ratio). Consult the manufacturer of the replacement joint seal material about the recommended shape factor. If a saw is used to reface the joint, flush the joint with water immediately after sawing. Remove any remaining debris by sand blasting each face of the joint reservoir.

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

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

e. Install new dry backer rod.

f. Seal joints with hot or cold compounds. Sealants should be placed as noted in paragraph 13.

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

5. **<u>Scaling, Map Cracking, and Crazing</u>**: 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:

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

b. 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.

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

d. 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).

e. 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. The mix should be air-entrained and designed to produce a no slump concrete, which will require tamping to place in the patch.

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

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

6. **Joint Spalling and Corner Spalling**: The procedure for the repair of spalls is as follows:

a. 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.

b. 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.

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

d. 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).

e. Place a thin strip of wood or metal coated with bond-breaking material in the joint groove and tarp 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.

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

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

(7**)** **<u>Blowups</u>**: Blowups may be repaired using the following procedures:

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

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

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

d. 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.

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

f. 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.

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

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

8. **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.

9. **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. Slab jacking procedures may be used to correct this type of distress. In slab jacking, 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, slab jacking is usually best performed by specialty contractors.

10. **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.

11. **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.

12. **Contaminants**: Remove rubber deposits with high-pressure water or biodegradable chemicals.

13. **<u>Temporary Patching of Concrete Pavements</u>**: Broken concrete areas can be patched with bituminous concrete as an interim measure. Full-depth bituminous repairs will interrupt the structural integrity of the rigid pavement and may lead to additional failures. Consequently, such full-depth repairs should be considered temporary, and corrective long-term repairs should be scheduled. Temporary repair for corner cracks, diagonal cracks, blowups, and spalls can be made using the following procedures:

a. Make a vertical cut with a concrete saw completely through the slab.

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

c. Add subbase/subgrade material if required, and compact.

d. Apply a prime coat to the subbase material.

e. Apply a tack coat to the sides of the slab.

f. Place bituminous concrete in layers not exceeding 3 inches (75 mm).

g. Compact each layer with a vibratory-plate compactor, roller, or mechanical rammers. For partial-depth repairs, make a vertical cut approximately 3 inches (75 mm) deep, apply tack coat, and place bituminous concrete in one layer. Normal traffic may be permitted on bituminous patches immediately after completion of the patch.

Summary of Repair Options

PROBLEM	PROBABLE CAUSE	REPAIR
Crack and joint sealer missing or not bonded to slabs.	Faces of joints (cracks) not clean when filled; incorrect application temperature of sealer; wrong kind of seal material; improper joint width.	Remove old material sealer if extensive areas affected; sandblast joints and cracks; reseal properly.
Random cracking	Uncontrolled shrinkage (improper joint spacing); over stressed slabs; slab support lost; subgrade settlement; bitumen too hard or overheated in mix.	Seal newly formed cracks; replace sub-base to establish support if pavement is being overloaded.
Surface scaling or breakup	**Rigid Pavement** - Overworked finishing operation; inadequate curing. **Flexible Pavement** - Overheated binder; poor aggregate gradation; insufficient binder; incorrect binder or aggregate; fuel spillage, stripping.	**Rigid Pavement** - Remove and replace replace panel; resurface with thin bonded concrete; resurface area with a bituminous concrete. **Flexible Pavement**- Apply seal coat; overlay.

PROBLEM	PROBABLE CAUSE	REPAIR
Joint (1) faulting or (2) spalling	(1) Variable support for un-bonded slabs; loss of load-transfer capability. (2) Incompressible matter in joint spaces; excessive joint finishing.	(1) Remove problem slab; replace slab (dowel to existing pavement). (2) Clean joint; refill with bituminous-sand mix; reseal.
	Saturated pavement foundation; lack of subbase.	Prevent entrance of water (correct the drainage problem); pump slurry under slabs to reseal; replace slabs and slab foundation; install drainage.
Surface irregularities (rutting, washboarding, birdbaths, undulations)	**Rigid Pavement** - Poor placing control; broken slabs; poor finishing. **Flexible Pavement**– Non-uniform settlement from inadequate compaction of pavement components or fill; unstable mix (poor aggregate gradation, too rich, etc.); poor laying control.	**Rigid Pavement** - Patch local areas, or overlay if widespread. **Flexible Pavement** - Patch local areas; apply leveling course; roto-mill.
PROBLEM	**PROBABLE CAUSE**	**REPAIR**
Bleeding of bituminous binder	Too much binder in mix (overly rich mix).	Scrape off excess material; blot with sand. **NOTE**: Bleeding is usually an indication that other surface deformities (rutting, washboarding, etc.) will occur.
Potholes	Water entering pavement structures; segregation in base course material.	Remove and replace base (and subbase if required); replace surface and seal.
Oxidation of bituminous binder	Lack of timely seal coat; binder overheated in mixing; wrong grade of asphalt for climate.	Apply seal coat; heater planer; resurface.

Map cracking, Crazing, alligator cracking	**Rigid Pavement**- Excessive surface finishing; Alkali-Aggregate Reactivity. **Flexible Pavement**- Overload; oxidized binder; under designed surface course (too thin).	**Rigid Pavement** - If surface deforms or breaks, resurface, grind. **Flexible Pavement**- Overlay; apply seal coat.
Popouts at joints	Dowel misaligned.	Fill popout hole with bituminous concrete or bituminous sand mix (if recurring, may require replacement of slabs).
PROBLEM	**PROBABLE CAUSE**	**REPAIR**
Slab blowup	Incompressible material in joints preventing slab from expanding; Alkali-Aggregate Reactivity.	Replace slab in blowup area; clean and reseal joints.
Slipperiness	**Rigid Pavement**- Improper finish (too smooth); improper type of curing membrane; excessive curing membrane; polished aggregate, rubber deposits. **Flexible Pavement**- Overly rich mix; poorly designed mix; polished aggregate; improperly applied seal coat; wrong kind of seal coat; rubber deposits.	**Rigid Pavement** - If finish too smooth, resurfacing required to provide texture; wire broom to remove curing membrane; grooving; remove rubber. **Flexible Pavement**- Apply textured seal coat; grooving; remove rubber**.**

REFERENCES

Public Law 103-305, section 107
Amending Title 49, section 47105

Advisory Circular 150/5380-7
Pavement Management System

Advisory Circular 150/5380-6B
Guidelines and Procedures for Maintenance of Airport Pavements

America Society for Testing and Materials
ASTM D 5340 – 10

The Asphalt Institute
Asphalt in Pavement Maintenance

American Concrete Pavement Association
Concrete Pavement Repair

Airport Cooperative Research Program
Common Airport Pavement Maintenance Practices

FDOT's Airfield Pavement Inspection Reference Manual

Any questions or comments regarding the Airfield Distress Repair Manual, please contact:

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