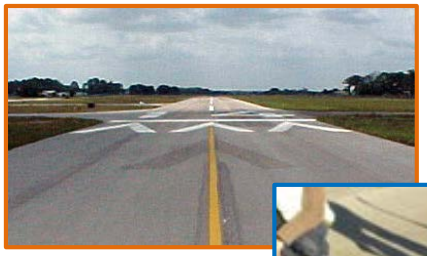
Florida Department of Transportation
AVIATION AND SPACEPORT OFFICE

STATEWIDE AIRFIELD PAVEMENT MANAGEMENT PROGRAM

AIRFIELD PAVEMENT INSPECTION

REFERENCE MANUAL





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PREFACE

This Airfield Pavement Inspection Reference Manual has been updated with the latest information from the FAA and the ASTM D5340-12. Additional distress pictures were added for clarity and easy recognition for inspectors while on the field. In 1995, the Congress of the United States mandated that the Federal Aviation Administration (FAA) require, as a condition of Grant in Aid that airports should be prepared to present documentation of a Pavement Management Program (PMP) for airfield pavement that has been constructed, reconstructed, or repaired with Federal assistance. This PMP Airfield Pavement Inspection Manual has been developed by the Florida Department of Transportation Central Aviation and Spaceport Office to assist Florida airport owner/operators comply with the FAA airfield pavement inspection requirements. Periodic and systematic airfield pavement inspections serve to enhance and extend the useful pavement life and provide for the safe use of various airfield pavements throughout the airport.

The Pavement Condition Index (PCI) method of documenting pavement conditions is the preferred choice of the FAA and was developed by the United States Army Corps of Engineers in the 1970s. This index allows for a systematic, standardized and objective assessment of pavement condition based on visual examination.

Use of Manual

Examples of various pavement distress types identified in this airfield pavement inspection manual are presented by name to assist airfield pavement inspectors. The various illustrations, charts and supporting descriptive information descriptions are presented to aid in the identification, severity, location, extent, and probable cause of pavement distress for both flexible and rigid pavement types.

The systematic visual inspection system can be used to establish a Pavement Management Program that can be specifically tailored to meet the individual and specific pavement maintenance needs of a particular airport.

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 ASTM, the U.S. Army Corps of Engineers for use in the Unified Facilities Criteria (UFC) O & M: Paver, Asphalt Surfaced Airfields Pavement Condition Index (PCI).

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.

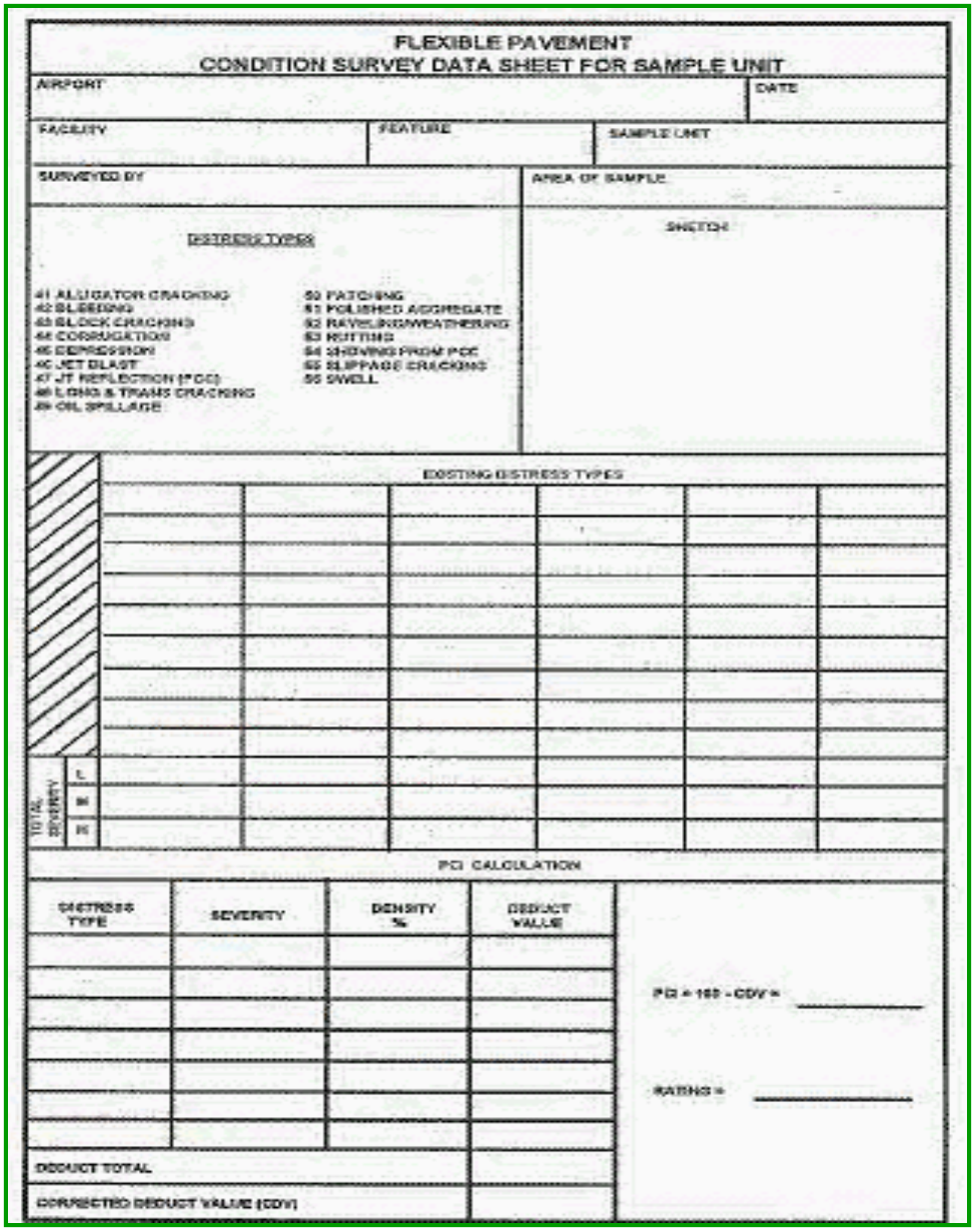
Table of Contents

Chapter I

Distresses in Flexible 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 AND UTILITY CUT PATCHING
11. POLISHED AGGREGATE
12. RAVELING
13. RUTTING
14. SHOVING
15. SLIPPAGE CRACKING
16. SWELL
17. WEATHERING

SURVEY DATA SHEET FOR ASPHALT PAVEMENT



FLEXIBLE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT | DATE

FACILITY | FEATURE | SAMPLE UNIT

SURVEYED BY | AREA OF SAMPLE

DISTRESS TYPES

41 ALLIGATOR CRACKING
42 BLEEDING
43 BLOCK CRACKING
44 CORRUGATION
45 DEPRESSION
46 JET BLAST
47 JT REFLECTION (PCC)
48 LONG & TRANS CRACKING
49 OIL SPILLAGE
50 PATCHING
51 POLISHED AGGREGATE
52 RAVELING/WEATHERING
53 RUTTING
54 SHOVING PCC
55 SLIPPAGE CRACKING
56 SWELL

SKETCH

EXISTING DISTRESS TYPES

TOTAL SEVERITY: L | M | H

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
DEDUCT TOTAL			
CORRECTED DEDUCT VALUE (CDV)			

PCI = 100 - CDV = _____

RATING = _____

For Flexible Pavements, the severity levels for the following distresses are not defined:

1) BLEEDING

2) JET-BLAST EROSION

3) OIL SPILLAGE

4) POLISHED AGGREGATE

5) SLIPPAGE CRACKING

(Source: ASTM D5340/ AC 150/ 5380- 6C)

DISTRESS No. 1: ALLIGATOR CRACKING

Description: Alligator or fatigue cracking is a series of interconnecting cracks caused by fatigue failure of the asphalt surface under repeated traffic loading. The cracking initiates at the bottom of the asphalt surface (or stabilized base) where tensile stress and strain is highest under a wheel load. The cracks propagate to the surface initially as a series of parallel cracks. After repeated traffic loading, the cracks connect and form many-sided, sharp-angled pieces that develop a pattern resembling chicken wire or the skin of an alligator. The pieces are less than 2-feet (0.6 meters) on the longest side.

Location: Alligator cracking occurs only in areas that are subjected to repeated traffic loadings, such as wheel paths. Therefore, it would not occur over an entire area unless the entire area was subjected to traffic loading.

Causation: Repeated dynamic loading on the asphalt surface that leads to fatigue failure of the asphalt causes the distress. Alligator cracking is considered a major structural distress.

Measurement: Alligator cracking is measured in square feet (meters) of surface area. The major difficulty in measuring Alligator distress is that two (2) or three (3) levels of severity often exist within the measured distressed area. If the different levels of severity cannot be easily divided, the entire area should be rated at the highest severity level present. If alligator cracking and rutting occur in the same area, each is recorded separately at its respective severity level.

Note: If alligator cracking and rutting occur in the same area, each is recorded separately at its respective severity level.

Severity Summary Table		
Severity	**DESCRIPTION**	**Spalling/FOD**
L	Fine, longitudinal hairline cracks running parallel to each other with no or only a few interconnecting cracks.	None
M	Further development of light alligator cracking into a pattern or network of cracks that may be slightly spalled. Well-defined pattern of interconnecting cracks, where all pieces are firmly held in place.	Slightly
H	Network or pattern cracking has developed so that pieces are well-defined and spalled at the edges; some of the pieces are loose and rock under traffic.	Well defined

Note:

- If different levels of severity cannot be easily divided, the entire area should be rated at the highest severity level present.
- If alligator cracking, block cracking, and rutting occur in the same area, each is recorded separately at its respective severity level.
- If the pavement is fragmented along a crack, the crack is said to be spalled

Low Severity Alligator Crack: Fine, longitudinal hairline cracks.

Medium Severity Alligator Crack: Pattern or network of cracks

High Severity Alligator Crack: Pieces are well defined and spalled at edges

DISTRESS No. 2: BLEEDING

Description: Bleeding is a film of bituminous material on the pavement surface that creates a shiny, glass-like; reflecting surface that usually becomes quite sticky.

Location: Bleeding can occur anywhere on the surface of the asphalt because it is caused by and during construction.

Causation: Bleeding is caused by excessive amounts of asphalt cement or tars in the mix and/or low air-void content. It occurs when asphalt fills the voids of the mix during hot weather and then expands onto the surface of the pavement. Since the bleeding process is not reversible during cold weather, asphalt or tar will accumulate on the surface.

Severity Levels: No degrees of severity are defined.
Bleeding should be noted when it is extensive enough to cause a reduction in skid resistance.

Measurement: Bleeding is measured in square feet (square meters) of surface area. If bleeding is counted, polished aggregate is not counted in the same area.

Bleeding: **No severity defined**

DISTRESS No. 3: BLOCK CRACKING

Description: Block cracks are interconnected cracks that divide the pavement into approximately rectangular pieces. The blocks may range in size from approximately 1 x 1 foot to 10 x 10 feet.

Location: Block cracking normally occurs over a large proportion of pavement area but sometimes will occur in non-traffic areas. This type of distress differs from alligator cracking in that alligator cracks are caused by repeated traffic loadings and, therefore, are located only in traffic areas (i.e., wheel paths.

Causation: Block cracking is caused mainly by shrinkage of the asphalt concrete (AC) and daily temperature cycling (which results in daily stress/strain cycling). It is not load-associated. The occurrence of block cracking usually indicates that the asphalt has hardened significantly. This type of distress differs from alligator cracking in that alligator cracks form smaller, many-sided pieces with sharp angles

Measurement: Block cracking is measured in square feet (square meters) of surface area. It usually occurs at one severity level in a given pavement section; however, any areas of the pavement section having distinctly different levels of severity should be measured and recorded separately. For asphalt pavements, not including AC over PCC, if block cracking is recorded, no longitudinal and transverse cracking should be recorded in the same area. For asphalt overlay over concrete, block cracking, joint reflection cracking, and longitudinal and transverse cracking reflected from old concrete should all be recorded separately.

Severity Summary Table				
Severity	**Non-Filled Cracks**	**Filler Condition**	**Spalling**	**FOD**
L	**General condition:** 1/ If Non filled, the Mean ≤ ¼” 2/ If Filled, then…	N/A filler must be in good condition.	None or Minor N/A	No N/A
M	**General condition:** 1/ If Non-filled, the Mean >¼” 2/ If Filled, the Mean also > ¼”.	Can be Filled or Non-filled N/A filler is in unsatisfactory condition	Moderately None or Minor None or Minor	Some potential Some potential Some potential
H	Well Defined	N/A	Severely	Definite Potential

Notes:

- If a crack is determined as a **LOW** severity level but it has some **spalling**, rate it as a **MEDIUM** Severity level crack.

- For asphalt pavement, not including AC over PCC, in the same sample unit where block cracking and longitudinal / transverse cracking both appear, measure the block cracking first and mark the areas with paint, then record the latter. This method will help to **prevent recording the** same crack for both distress types.

Low severity Block Cracking: Cracks that are non-spalled.

Medium Severity Block Cracking: moderately spalled (Some FOD potential)

High Severity Block Cracking: Cracks that are severely spalled (FOD highly possible).

DISTRESS No 4: CORRUGATION

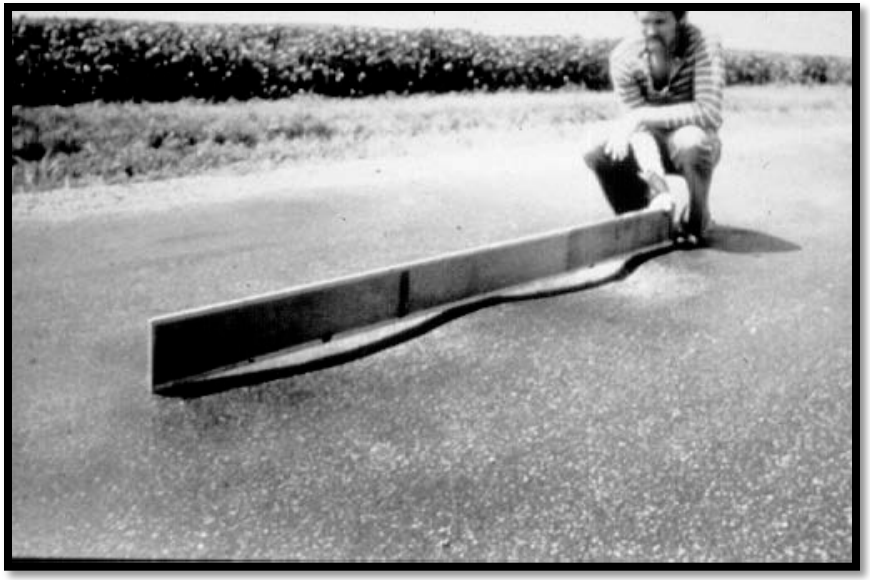
Description: Corrugation is a series of closely spaced ridges and valleys (ripples) occurring at fairly regular intervals (usually less than 5 feet) (1.5 meters) along the pavement. The ridges are perpendicular to the traffic direction.

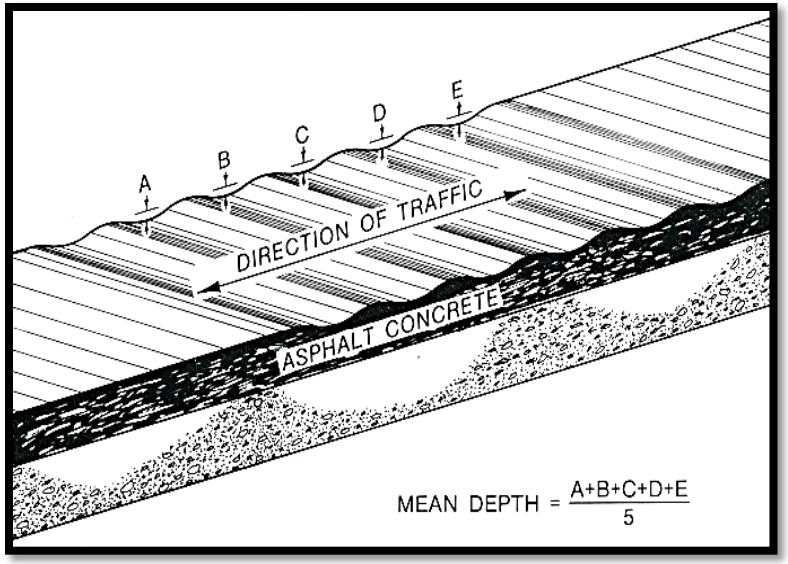
Location: Corrugation is not commonly found on airfield pavement, but when found, it is perpendicular to the direction of plane taxiing and take-off.

Causation: Traffic action combined with an unstable pavement surface or base usually causes this type of distress.

Measurement: Corrugation is measured in square feet (square meters) of surface area. The mean elevation difference between the ridges and valleys of the corrugations indicates the level of severity. To determine the mean elevation difference, a 10-feet (3-meter) straightedge should be placed perpendicular to the corrugations so that the depth of the valleys can be measured in inches (millimeters). The mean depth is calculated from five such measurements.

Severity Summary Table		
Maximum Depth of Corrugation		
Severity	Runways and High-Speed Taxiways	Taxiways and Aprons
L	Corrugations are minor, do not effect ride quality < 1/4“,	< ½ in.
M	Corrugations are noticeable & badly effect ride quality 1/4 to 1/2“,	Between 1/2 to 1 in.
H	Easy to notice & severely affects ride quality > 1/2 “	>1 in.





Measurement and Observation – Calculating the mean depth, and the standard method of measurement using the straight edge.

Low: corrugations are minor

Medium: Corrugations are noticeable.

CORRUGATION

High: Corrugations severally affect ride ability.

DISTRESS No. 5: DEPRESSION

Description: Depressions are localized pavement surface areas having elevations slightly lower than those of the surrounding pavement.

Location: Depression can occur anywhere on the pavement. In many instances, light depressions are not noticeable until after a rain, when ponding water creates “birdbath” areas; but the depressions can also be located without rain because of stains created by ponding water.

Causation: Depressions can be caused by settlement of the foundation soil or can be “built up” during construction. Depressions cause roughness and, when filled with water of sufficient depth, can cause hydroplaning of aircrafts.

Measurement: Depressions are measured in square feet (square meters) of surface area. The maximum depth of the depression determines the level of severity. This depth can be measured by placing a 10-feet straightedge across the depressed area and measuring the maximum depth in inches. Depressions larger than 10 feet (3 meters) across must be measured by either visual estimation or direct measurement when filled with water.

Severity Summary Table

Maximum Depth of Depression				
Severity	RWs & H/S Taxiways	Taxiways & Aprons	Affect R/Q	Hydroplaning Potential
L	Observable 1/8 - ½"	1/2 - 1 in.	Slightly	Possible
M	Observable > ½ - 1	> 1 - 2 in.	Moderately	Causes
H	Clearly Noticed > 1"	> 2 in.	Severely	Causes

Low Severity Depression: Slightly affects pavement riding quality

Medium Severity Depression: Moderately affects pavement riding quality

High Severity Depression: Leads to ponding and can cause hydroplaning of aircrafts

DISTRESS No. 6: JET BLAST EROSION

Description: Jet blast erosion causes darkened areas on the pavement surface when bituminous binder has been burned or carbonized; localized burned areas may vary in depth up to proximately 1/2 inch.

Location: This distress type is most commonly found at the ends of runways where aircrafts “spool up” before releasing brakes for takeoff.

Causation: The distress is caused by ram jet engines of military fighter aircraft and to a lesser extent by turbofan engines of commercial jets.

Severity Levels: No degrees of severity are defined. It is sufficient to indicate that jet blast erosion exists

Measurement: Jet blast erosion is measured in square feet (square meters) of surface area.

Jet Blast Erosion: (**No severity**) Common at the end of runways

DISTRESS No 7: JOINT REFLECTION CRACKING FROM PCC

Description: This distress occurs only on pavements that have an asphalt or tar surface over a PCC slab. This category of distress does not include reflection cracking from any other type of base (i.e., cement stabilized, lime stabilized); such cracks are listed as longitudinal and transverse cracks. Joint reflection cracking is pattern cracking and follows the underlying PCC pavement joint pattern. The pattern may be difficult to distinguish in early stages of reflection; however, it becomes noticeable when looking over a large expanse of pavement.

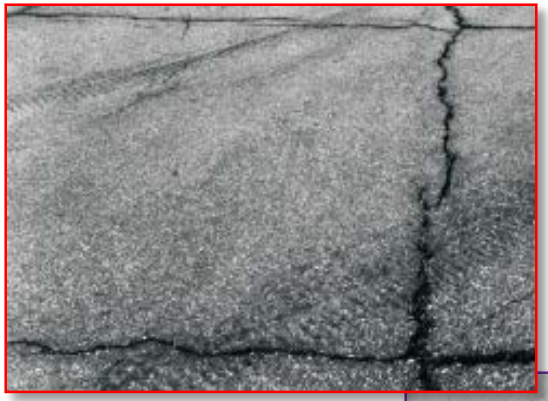
Location: Covers the entire asphalt pavement having an underlying PCC slab.

Causation: Joint-reflection cracking is caused mainly by movement of the PCC slab beneath the AC surface because of thermal and moisture changes; it is not load related. However, traffic loading may cause a breakdown of the AC near the crack, resulting in spalling and FOD potential. If the pavement is fragmented along a crack, the crack is said to be spalled. Knowledge of slab dimensions beneath the AC surface will help to identify these cracks.

Measurement: Joint-reflection cracking is measured in linear feet (linear meters). The length and severity level of each crack should be identified and recorded. If the crack does not have the same severity level along its entire length, each portion should be recorded separately. For example, a crack that is 50 feet (15 meters) long may have 10 feet (3 meters) of high severity, 20 feet (6 meters) of medium severity, and 20 feet (6 meters) of light severity; these would all be recorded separately.

Severity Summary Table

Severity	Non-Filled Cracks	Filled Filler Condition	Filled or Non-Filled	
			Spalling	FOD
L	**General condition:**			
	1/ Filled or Non-filled	N/A	Little or No	Little or No
	2/ If Non-Filled, the Mean ≤ ¼”	N/A	N/A	N/A
	3/ If Filled: Any Width	Filler in Satisfactory condition	Little or No	Little or No
M	**General condition:**			
	1/ Filled or Non-filled, any Width	N/A	Moderate	Some
	2/ If the cracks are filled,	Filler is unsatisfactory condition	None or Minor	Some
	3/ N-filled, Mean >1/4”,	N/A	None or Minor	Some
	4/ Light cracking appears near the crack or at the corner of intersecting cracks.	N/A	None or Minor	Some
H	Can be any width,	Can be Filled or Non-filled	Severe,(loose/ missing pieces)	Definite Potential



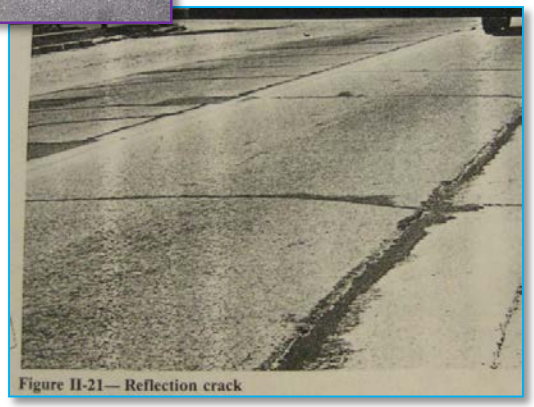


Figure II-21— Reflection crack

Joint reflection cracks may meander back and forth across the PCC joint

Joint reflection cracks follow straight lines

DISTRESS No. 8: LONGITUDINAL/TRANSVERSE CRACKING (NON-PCC JOINT REFLECTION)

Description: Longitudinal cracks are parallel to the pavement's center-line or laydown direction, while transverse cracks extend across the pavement at approximately right angles to the pavement's center line or direction of laydown.

Location: Covers the entire asphalt pavement.

Causation: They may be caused by (1) a poorly constructed paving lane joint; (2) shrinkage of the AC surface due to low temperatures or hardening of the asphalt; or (3) a reflective crack caused by cracks beneath the surface course, including cracks in PCC slabs (but not at PCC joints).

Transverse cracks may be caused by items 2 or 3 above. These types of cracks are not usually load-associated. If the pavement is fragmented along a crack, the crack is said to be spalled.

Measurement: Longitudinal and transverse cracks are measured in linear feet (linear meters). The length and severity of each crack should be identified and recorded. If the crack does not have the same severity level along its entire length, each portion of the crack having a different severity level should be recorded separately. For example, a crack that is 50 feet (15 meters) long may have 10 feet (3 meters) of high severity, 20 feet (6 meters) of medium severity, and 20 feet (6 meters) of light severity; these would all be recorded separately.

Severity Summary Table *(as for JRC from PCC)*

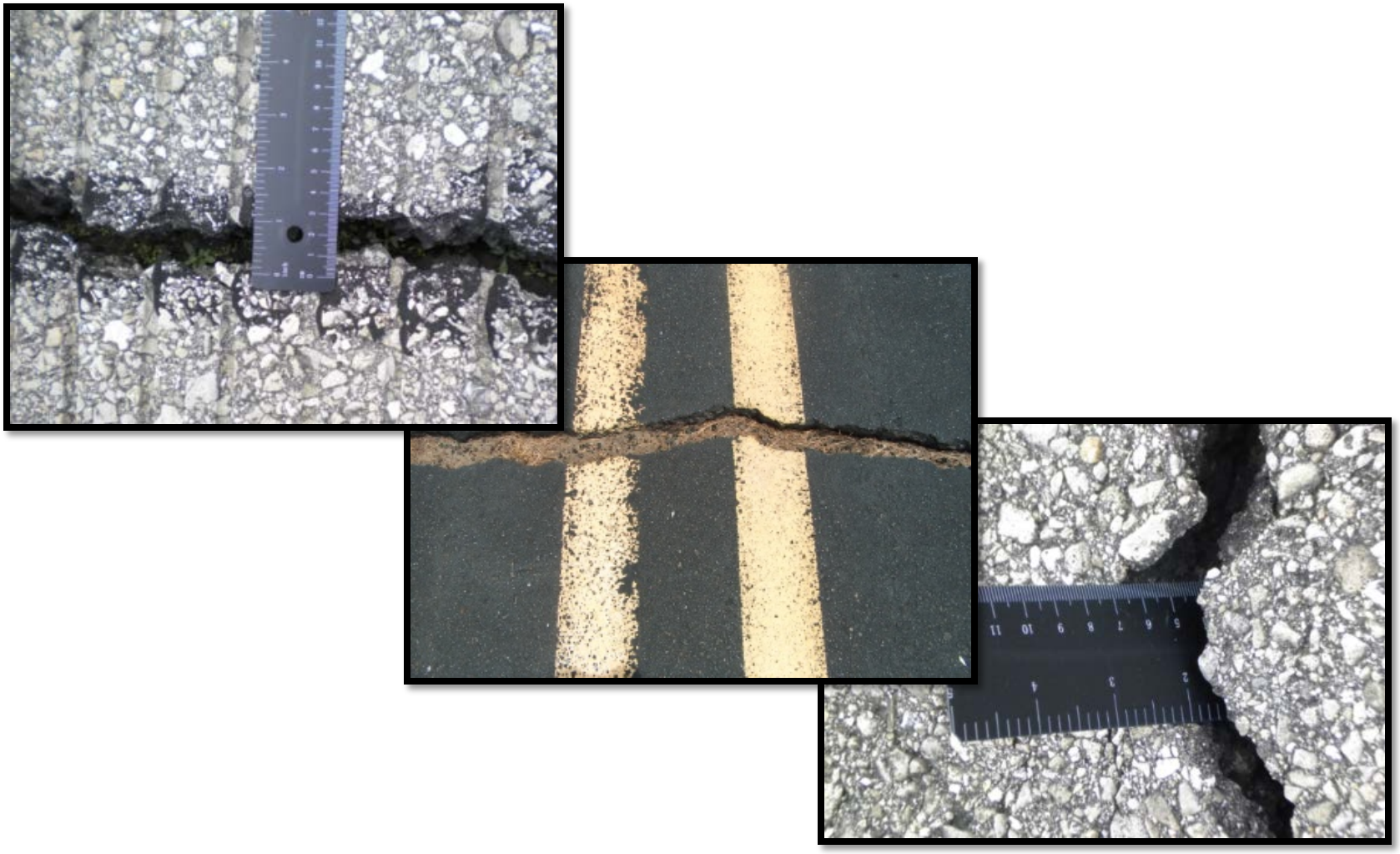
Severity	Non-filled Cracks	Filled Filled Condition	Filled – or Non-filled	
			Spalling	FOD
L	**General condition :** 1/ Non Filled, **Mean** ≤ ¼” 2/ Filled: any Width,	Can be Filled or Non-filled N/A Filler in satisfactory condition	Little or No Little or No Little or No	Little or No Little or No Little or No
M	**General condition:** 1/ Any Width, 2/ If Filled crack, 3/ If Non-filled, **Mean** >1/4” 4/ Light cracking appears near the crack or at the corner of intersecting cracks.	Can be Filled or Non-filled Filler is Un-satisfactory condition N/A	Moderately None or Minor None or Slightly	Some potential Some potential Some potential Some potential
H	Can be any Width	Can be Filled or Non-filled	Severely	Definite Potential.

Note:

- If a low severity linear crack branches out from a long, low linear crack and does not join the parent crack again, they are to be recorded as two separate low linear cracks.
- If the smaller crack joins the parent crack again within 2 ft and the distance between the two cracks is small (6“ or less), this portion of the crack should be recorded as a medium severity linear crack.
- If the crack does not have the same severity level along its entire length, each portion of the crack with a different severity level should be recorded separately.
- If the pavement is fragmented along a crack, the crack is said to be spalled.

Low Severity Longitudinal/Transverse Cracking: The cracks appear the same either longitudinal or transverse to the runway

Medium Severity Longitudinal/Transverse Cracking: Moderately spalled (some FOD potential)



High Severity Longitudinal/Transverse Cracking: Combination of both longitudinal and transverse

Secondary cracking connects the original L crack

DISTRESS No. 9: OIL SPILLAGE

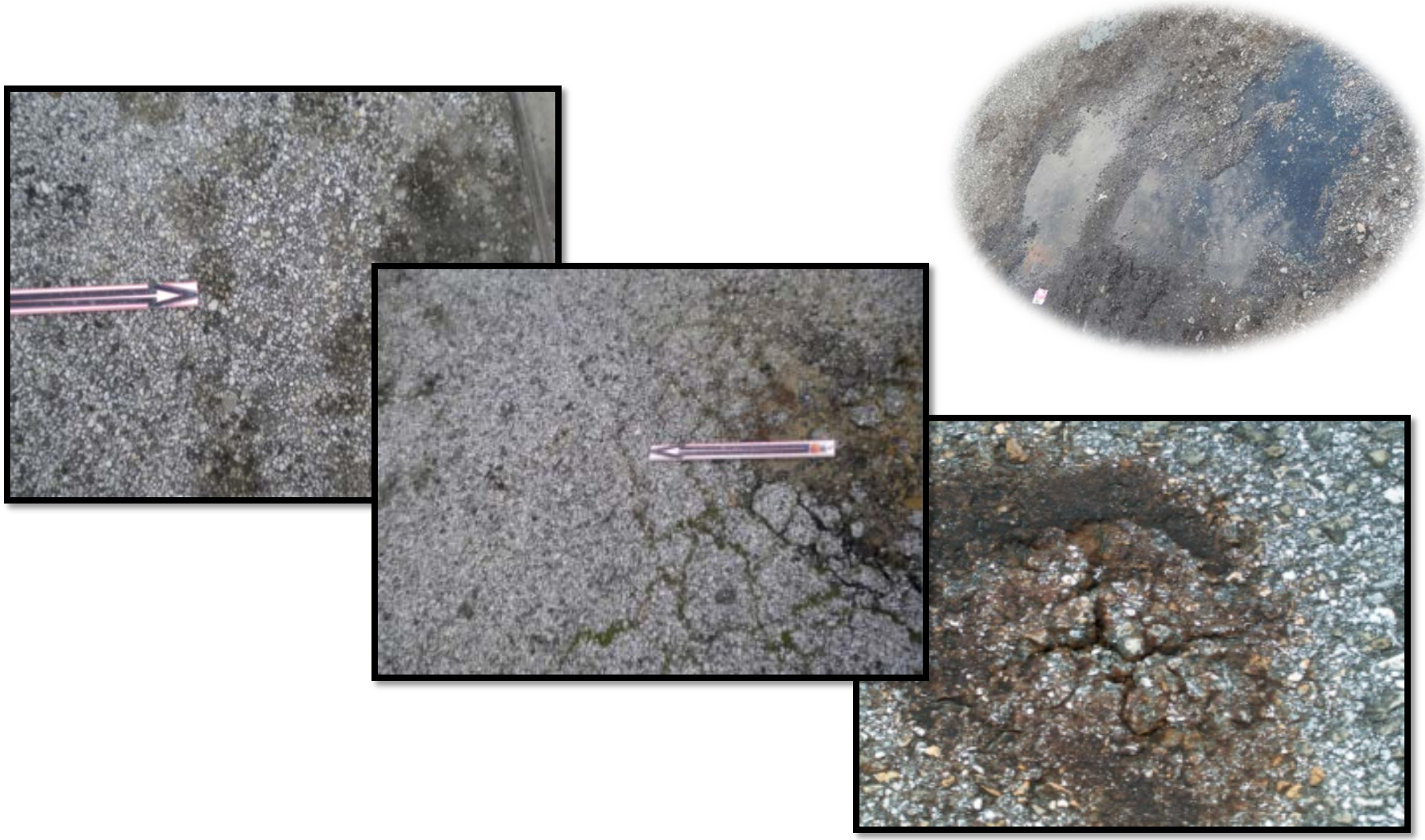
Description: Oil spillage is the deterioration or softening of the pavement surface caused by the spilling of oil, fuel, or other solvents.

Location: Anywhere on the pavement where the condition of the distress is created by oil or fuel spills. Oil spills are typically found around fuel pumps and in parking areas.

Causation: The loosening of the binder material in the asphalt is caused by the reaction of the oil solvents. A stain is not necessarily a distress unless the binder has been softened and the material has been lost.

Severity Levels: **No degrees of severity are defined**. It is sufficient to indicate that oil spillage exists.

Measurement: Oil spillage is measured in square feet (square meters) of surface area.



Oil Spillage: **No severity levels defined**

DISTRESS No. 10: PATCHING & UTILITY CUT PATCH

Description: A patch is an area of pavement that has been replaced with a new material to repair an existing pavement. In order for a patch to be recorded as a distress, a patch must replace an original pavement section. A patch is considered a defect, regardless of how well it is performing.

Location: Anywhere on the pavement where there had been a cut and where there is evidence to determine that original pavement has been removed and replaced.

Causation: Utility repairs across pavement.

The use of dense-graded AC patches in PFC surfaces causes a water damming effect at the patch that contributes to differential skid resistance of the surface. Low-severity, dense-graded patches should be rated as medium severity because of the differential friction problem. Medium- and high-severity patches are rated the same as above.

Measurement: Patching is measured in square feet (square meters) of surface area. However, if a single patch has areas of differing severity levels, these areas should be measured and recorded separately. For example, a 25-square-foot (2.3-square-meter) patch may have 10 square feet (1.0 square meter) of medium severity and 15-square-feet (1.4-square-meters) of light severity. These areas would be recorded separately. Any distress found in a patched area will not be recorded; however, its effects on the patch will be considered when determining the patch's severity level.

Severity Summary Table		
Severity	**Description**	**FOD Potential**
L	Patch is in good condition and is performing **well.**	**No**
M	Patch is somewhat deteriorated and affects riding quality to some extent. Moderate amount distress is present within the patch, or both.	**Yes**
H	Patch is badly deteriorated and affects riding quality significantly. Needs replacement.	**High**

Low Severity Patching and Utility Cut Patch: Good condition and is performing satisfactorily

Medium Severity Patching and Utility Cut Patch: Patch has deteriorated

High Severity Patching and Utility Cut Patch: Patch is badly deteriorated

DISTRESS No. 11: POLISHED AGGREGATE

Description: Polished aggregate is present when close examination of a pavement reveals that the portion of aggregate extending above the asphalt is either very small or there are no rough or angular aggregate particles to provide good skid resistance. Existence of this type of distress is also indicated when the number on a skid resistance rating test is low or has dropped significantly from previous ratings.

Location: Heavy traffic or wheel-path areas.

Causation: Polished aggregate is caused by repeated traffic applications

Severity Levels: **No degrees of severity** are defined. However, the degree of polishing should be significant before it is included in the condition survey and rated as a defect.

Measurement: Polished aggregate is measured in square feet (square meters) of surface area.

NOTE: If bleeding is counted, polished aggregate is not counted in the same area.

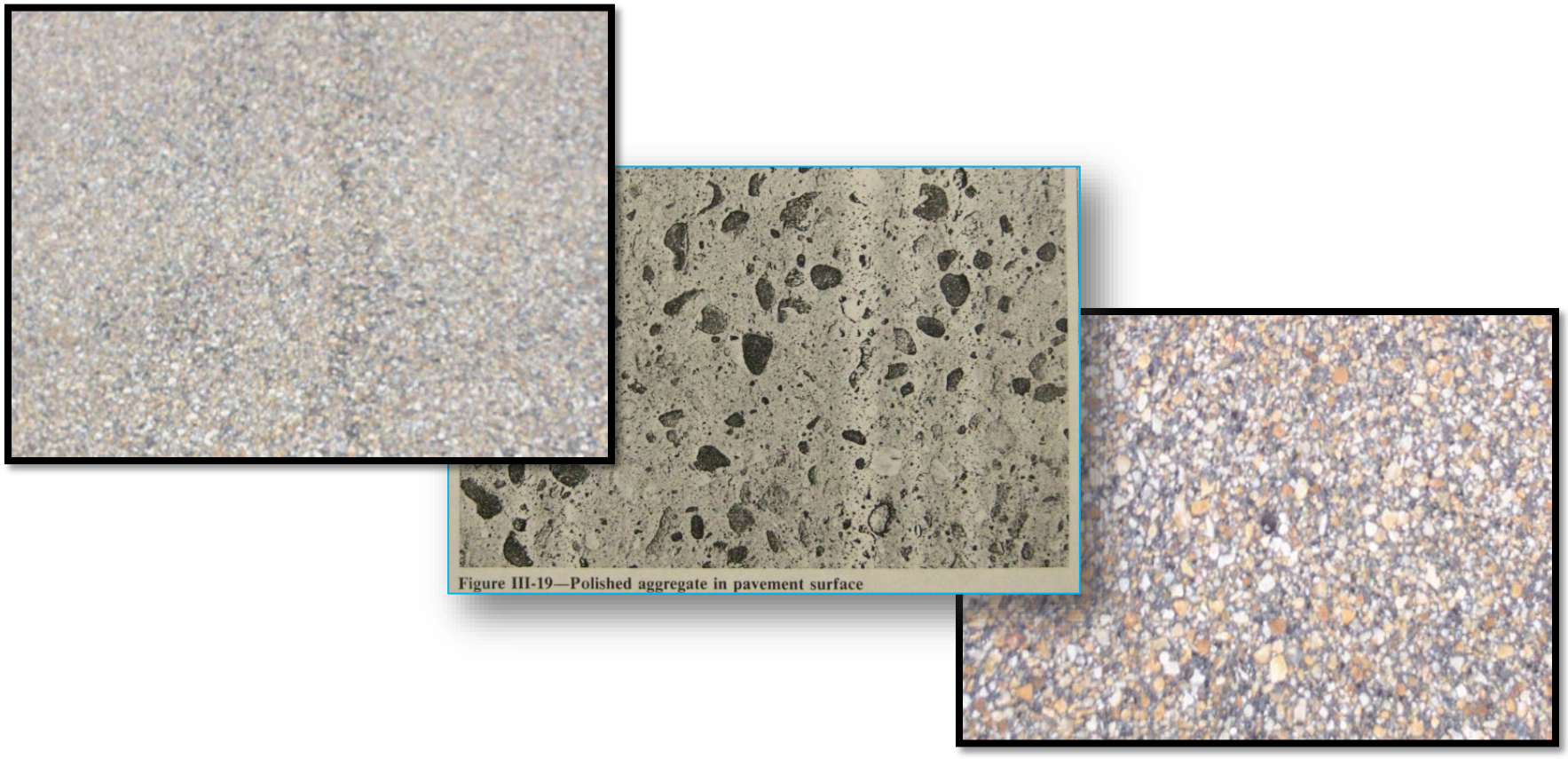


Figure III-19—Polished aggregate in pavement surface

Polished Aggregate: (**No severity**) the aggregate has to be smooth and polished

DISTRESS No. 12: RAVELING

Description: In the hot mix asphalt surface, there are two cases of raveling:
Non-Treatment Surface (Dense-Mix) is The dislodging of Aggregate Particles from the pavement surface.
Raveling with the treatment: The separation of the surface treatment from the original pavement surface.

Location: Heavy traffic or wheel-path areas. Areas affected by the related description.

Causation: Dense-Mix: This is a material related distress type often uniformly evident over large areas of pavement surface. If caused by construction, it may be found in lanes as from bad truckload mix, or in strips paralleling paving lanes. Other causes:

- lack of compaction
- not enough asphalt in the mix
- over heating of asphalt mix

Raveling with the treatment: The separation of the surface treatment from the original pavement surface.

Measurement: Raveling is measured in square feet (square meters) or surface area. Mechanical damage caused by hook drags, tire rims, or snow plows are counted as areas of high-severity raveling and weathering.

Note: If in doubt, inspect three (3) representative square yard

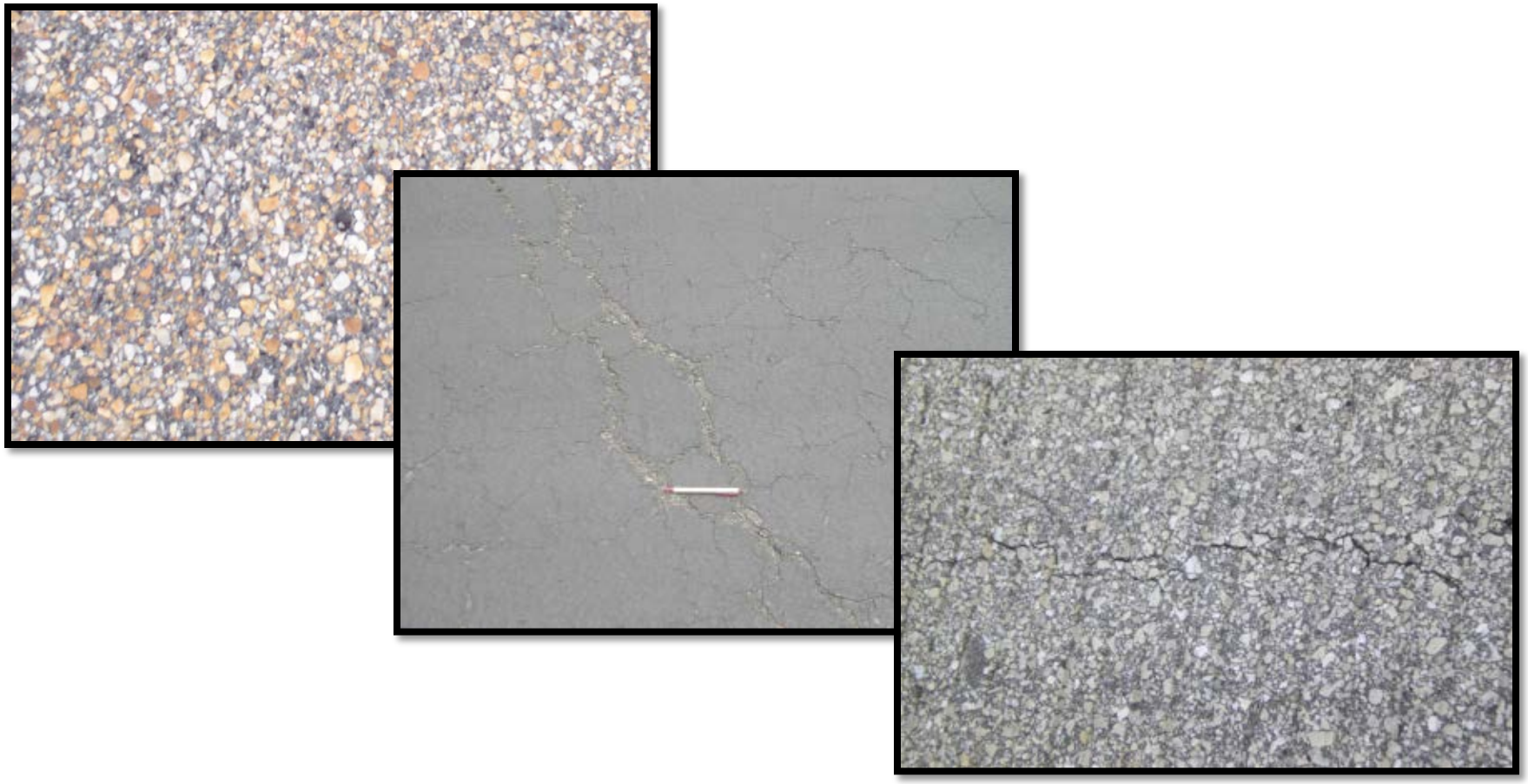
Severity Summary Table (Dense Mix Severity Levels)

Severity	General Condition	No. of aggregate missing in 1 sq. yd.	FOD Potential	Missing aggregate Clusters (per sq. yd.)	Severity Raveling
L	Surface is in **good condition**, but fine aggregate and binder have worn away.	5 - 20	Little or no	< 2%	Low
M	N/A	21 - 40	Some	2- 10%	Medium
H	N/A	> 40	Significant	>10%	High

Note: If in doubt, inspect three (3) representative square yard

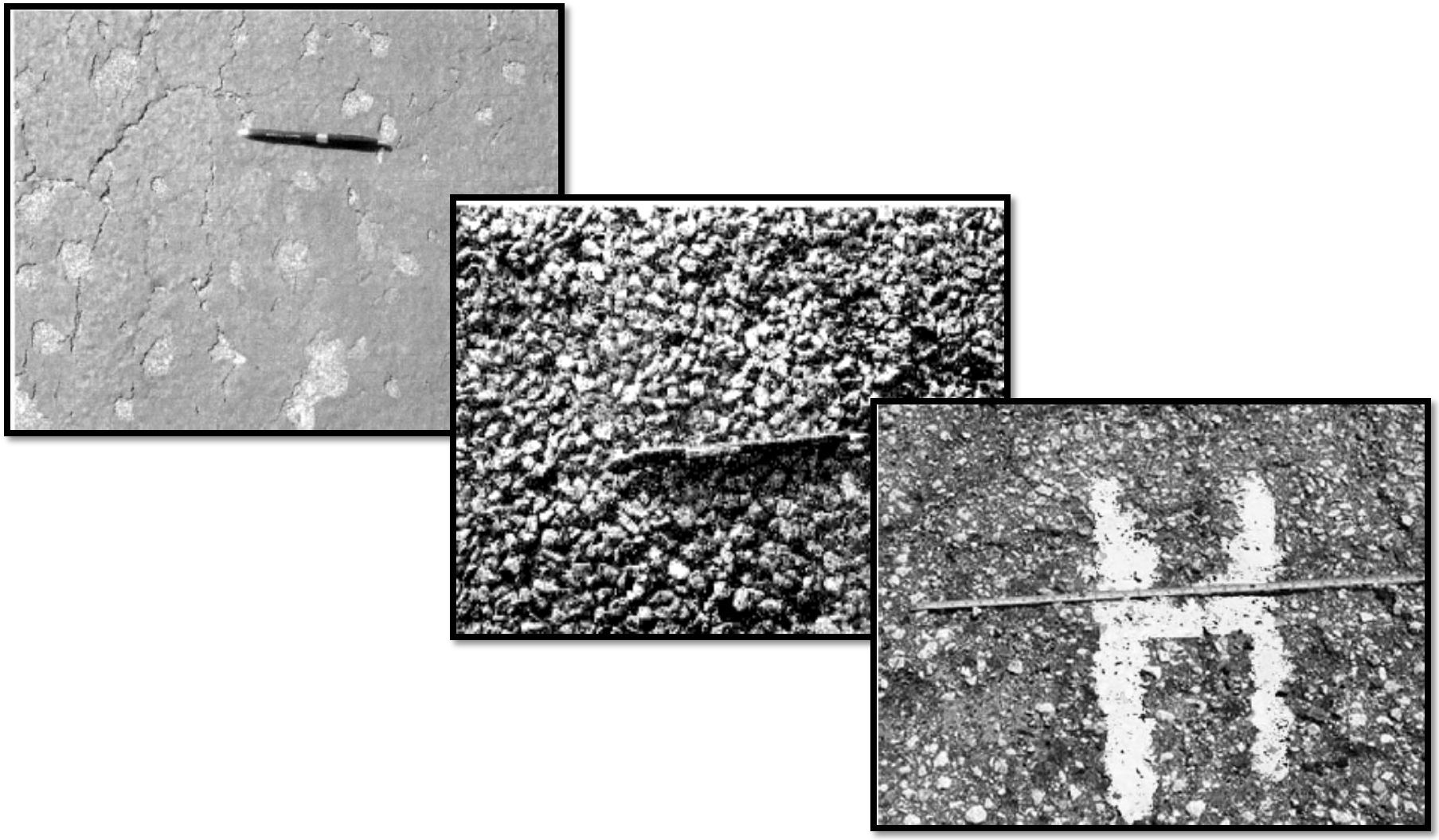
Slurry Seal/Coal Tar Over Dense Mix Severity Levels

Severity	Scale	In case of COLD TAR where pattern cracking has developed, the TAR SURFACE:
L	< 1%	The cracks are < ¼" wide
M	1-10%	The cracks are ≥ ¼" wide
H	> 10%	The tar is peeling off



Low Severity Raveling: Binders and fines have eroded away

Medium Severity Raveling: Nearly 50% of surface aggregate has eroded away



High Severity Raveling: Nearly all the surface aggregate has eroded away

DISTRESS No. 13: RUTTING

Description: A rut is a surface depression in the wheel path. Pavement uplift may occur along the sides of the rut; however, in many instances ruts are noticeable only after a rainfall, when the wheel paths are filled with water.

Location: Rutting can occur over large expanses of pavement on aprons and taxiways where traffic is not channelized.

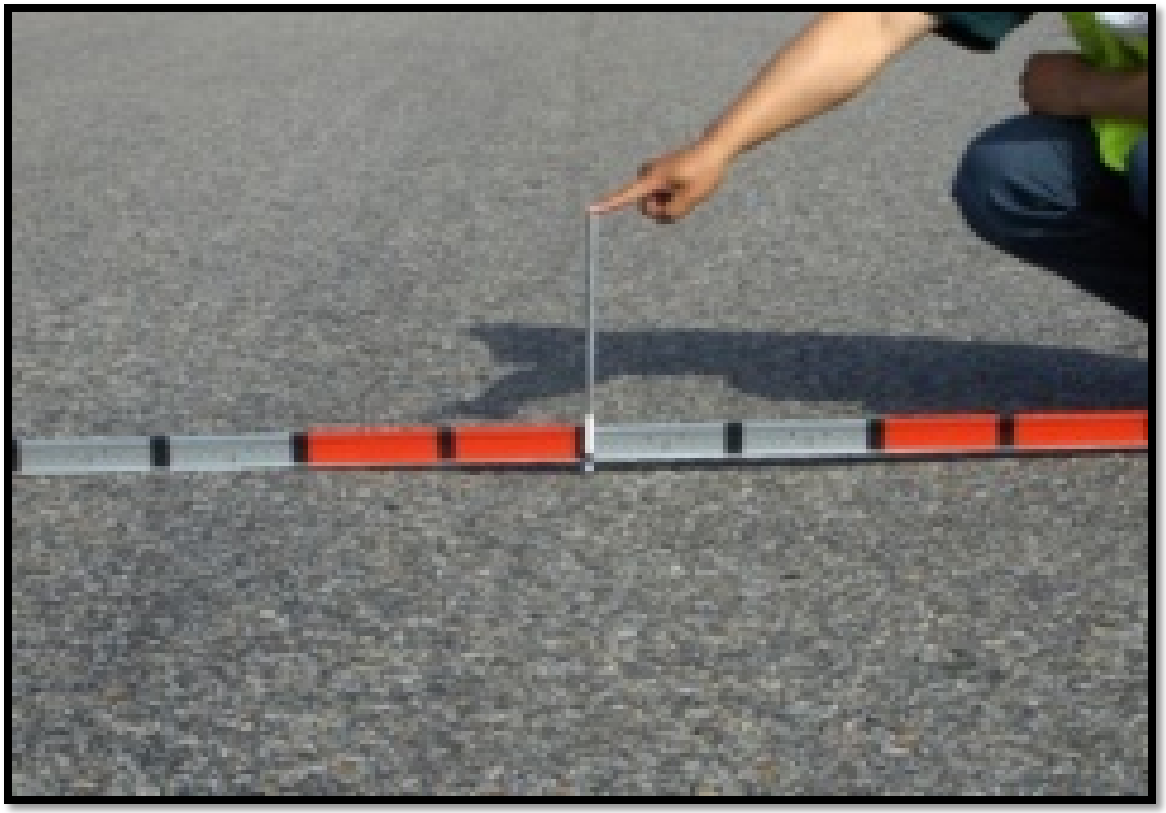
Causation: Rutting stems from a permanent deformation in any of the pavement layers or subgrade. It is usually caused by consolidation or lateral movement of the materials due to traffic loads. Significant rutting can lead to major structural failure of the pavement.

Measurement: Rutting is measured in square feet (square meters) of surface area, and its severity is determined by the depth of the rut. To determine the mean rut depth, a straightedge should be laid across the rut and the maximum depth measured. The mean depth in inches (millimeters) should be computed from measurements taken along the length of the rut. If alligator cracking and rutting occur in the same area, each is recorded at the respective severity level.

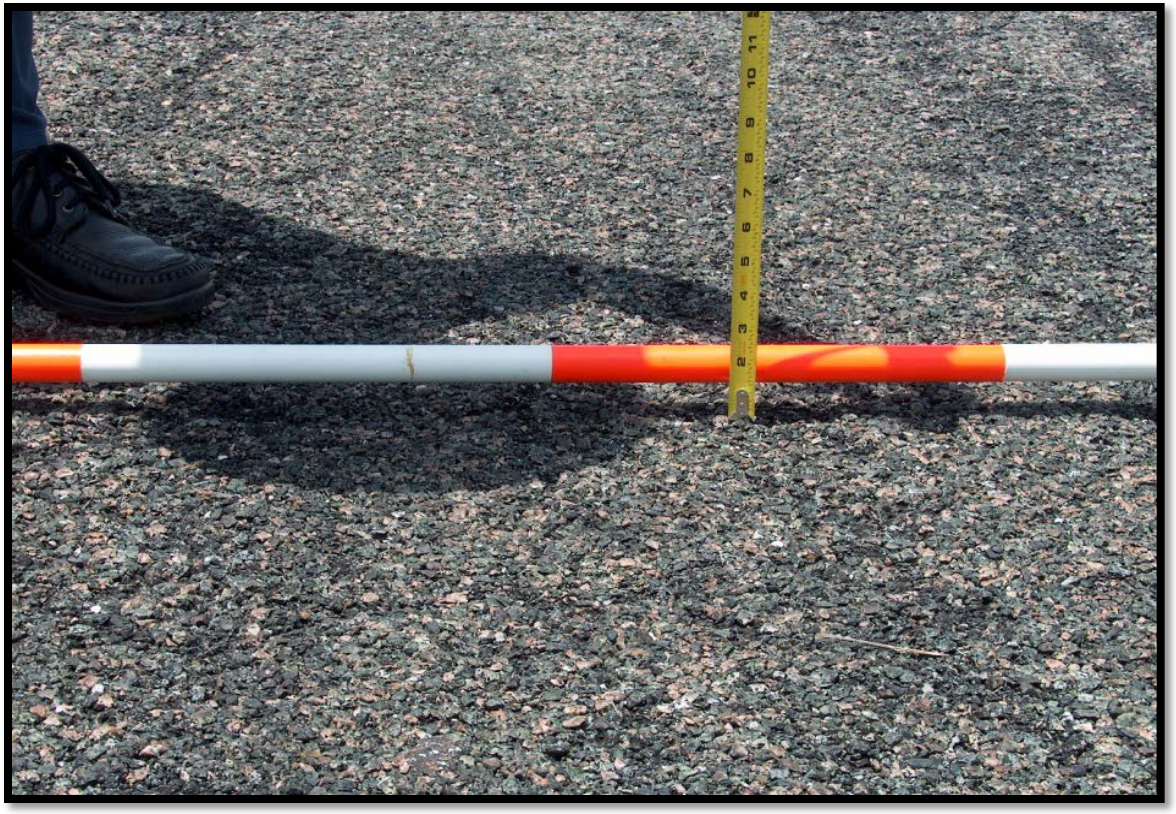
Severity Summary Table

(All pavement sections)	**Rut Depth**
L	**1/4 - 1/2".**
M	**>1/2 - 1".**
H	**> 1 in.**

Low Severity Rutting: Locate by visual inspection and with straight edge



Medium Severity Rutting: Mean depth exceeds ½-inch



High Severity Rutting: Mean depth > 1-inch

DISTRESS No. 14: SHOVING

Description. PCC pavements occasionally increase in length at ends where they adjoin flexible pavements (commonly referred to as "pavement growth"). This "growth" shoves the asphalt- or tar-surfaced pavements, causing them to swell and crack. A gradual opening of the joints causes the PCC slab "growth" as they are filled with incompressible materials that prevent them from reclosing.

Location: This distress occurs at interface between flexible and rigid pavement.

Causation: The increase in length of the PCC pavements push the asphalt pavement that produces the short, abrupt wave in the pavement surface associated with shoving.

Measurement: Shoving is measured by determining the area in square feet (square meters) of the swell caused by shoving.

Severity Summary Table		Height Differential
L	A slight amount of shoving has occurred, with little effect on ride quality and no break-up of the asphalt pavement	**< .75 "**
M	A significant amount of shoving has occurred, causing moderate roughness or break-up of the asphalt pavement.	**.75 – 1.5"**
H	A large amount of shoving has occurred, causing severe roughness or break-up of the asphalt pavement.	**> 1.5"**

Low Severity Shoving: Common at the interface between rigid and flexible pavement

Medium Severity Shoving: Evidence of compression of the flexible pavement by rigid pavement is necessary

High Severity Shoving: Severe roughness of breakup of the asphalt pavement

DISTRESS No.15: SLIPPAGE CRACKING

Description: Slippage cracks are crescent- or half-moon shaped cracks.

Location: This usually occurs when there is a low-strength surface mix or poor bond between the surface and next layer of pavement structure. Usually transverse to the direction of travel, having two ends pointed away from the direction of traffic.

Causation: They are produced when braking or turning wheels cause the pavement surface to slide and deform.

Severity Levels: No degrees of severity are defined. It is sufficient to indicate that a slippage crack exists.

Measurement: Slippage cracking is measured in square feet (square meters) of surface area.

Slippage usually occurs when there is low strength surface mix or poor bond between the surface and next layer of pavement. (**No severity**)

DISTRESS No. 16: SWELL

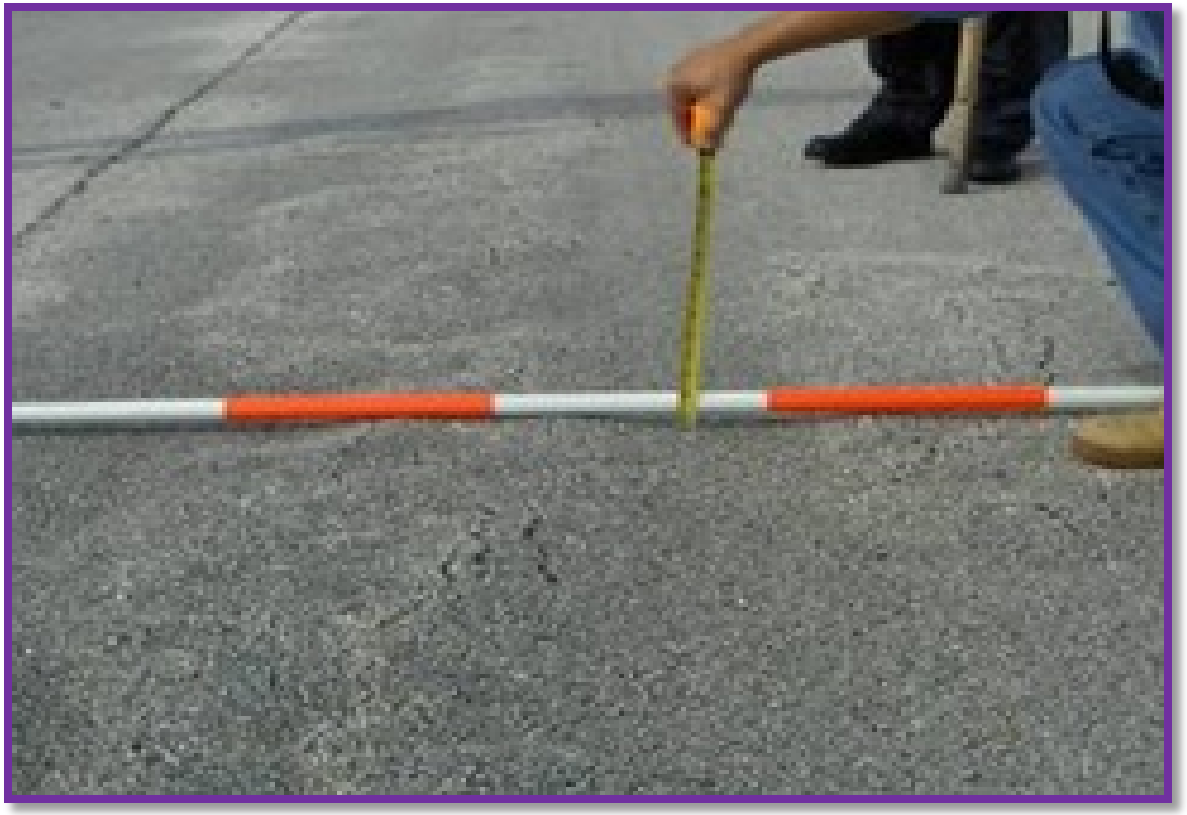
Description: Swell is characterized by an upward bulge in the pavement's surface – a long, gradual wave more than 10-ft (3-meter) long. A swell may occur sharply over a small area or as a longer, gradual wave. Either type of swell can be accompanied by surface cracking.

Location: This form of distress is not common in Florida due its cause and could be anywhere on the pavement.

Causation: A swell is usually caused by frost action in the subgrade or by swelling soil, but a small swell can also occur on the surface of an asphalt overlay (over PCC) as a result of a blow-up in the PCC slab.

Measurement: The surface area of the swell is measured in square feet (square meters). The severity rating should consider the type of pavement section (i.e., runway, taxiway, or apron). For example, a swell of sufficient magnitude to cause considerable roughness on a runway at high speeds would be rated as more severe than the same swell located on the apron or taxiway where the normal aircraft operating speeds are much lower. The following guidance is provided for runways:

Height Differential			
Severity		R/W	Other
L	Swell is barely visible and has a minor effect on the pavement's ride quality:	< ¾"	< 1.5"
M	Swell can be observed without difficulty and has a significant effect" on the pavement's ride quality :	3/4 - 1.5	1.5 – 3"
H	Swell can be readily observed and severely affects the pavement's ride Quality:	> 1.5"	> 3"



Low Severity Swell: Upward bulge < 1-1/2 inch high

Medium Severity Swell: Can be observed without difficulty

High Severity Swell: Can be readily observed and severely affects pavement ride ability

DISTRESS No. 17: WEATHERING

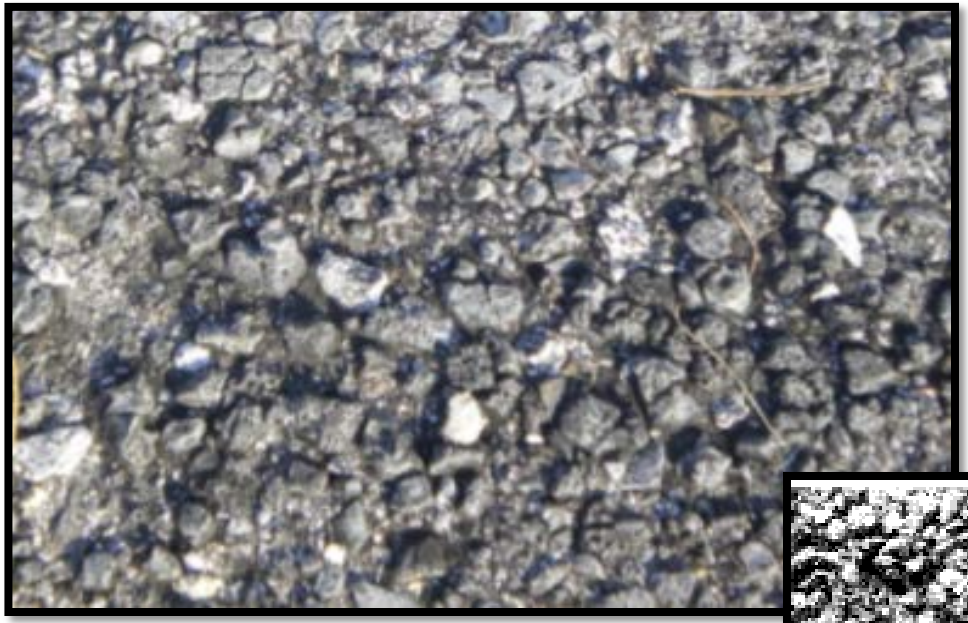
Description: The wearing away of the asphalt binder and fine aggregate from the pavement surface.

Location: Areas affected by the related description

Causation: Aging and climatic weather conditions

Measurement: Surface wear is measured in square feet (square meters). Surface wear is not recorded if medium or high severity raveling is recorded.

Severity Summary Table	
L	Asphalt surface beginning to show signs of aging and may be accelerated by climatic conditions. Minor loss of fine aggregates.
M	Loss of fine aggregates and exposed up to ¼ width (of the longest side) of the coarse aggregates.
H	Loss of fine aggregates and exposed greater than ¼ width (of the longest side) of the coarse aggregates, leading to potential loss of coarse aggregates.



WEATHERING Distress

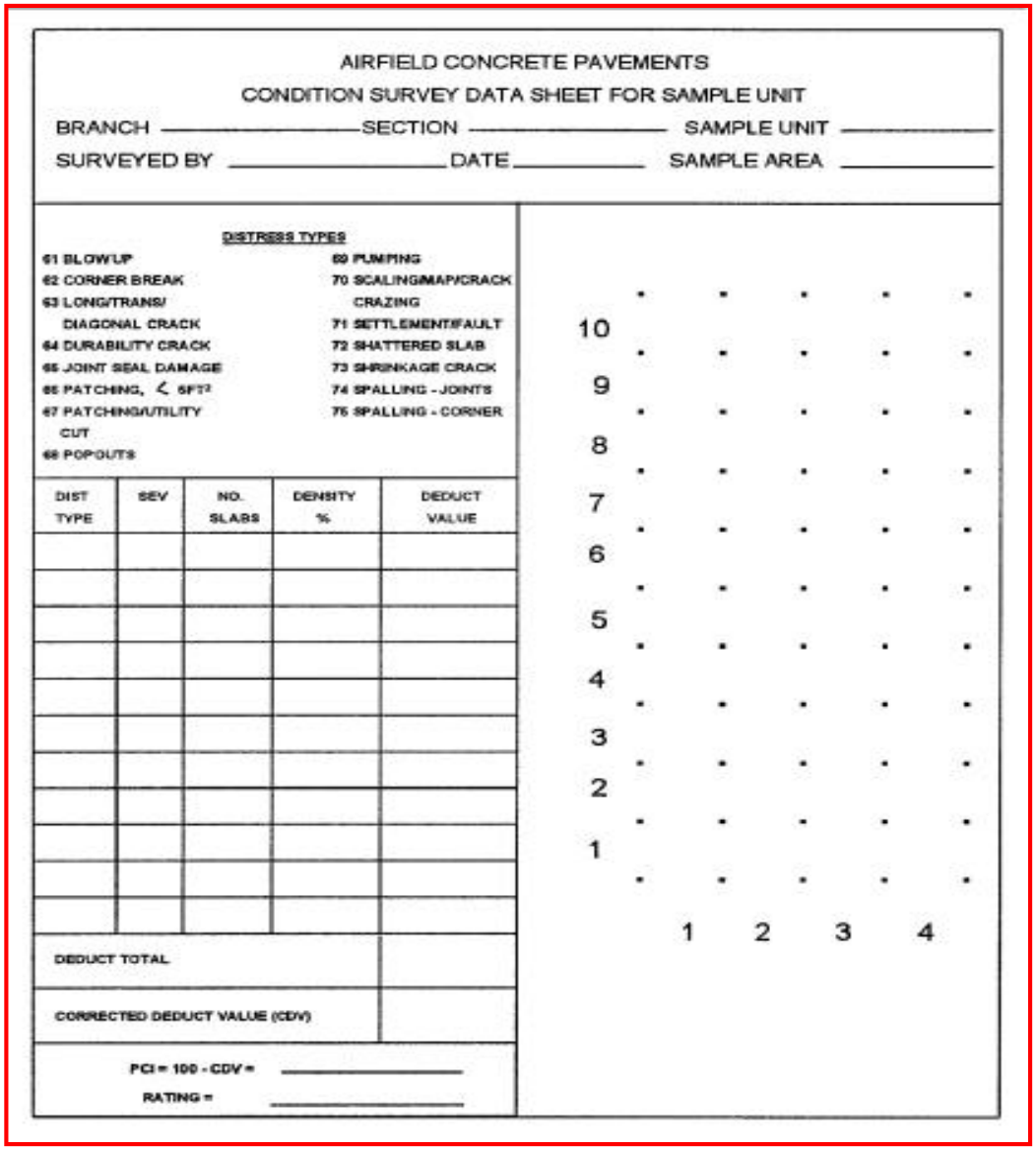
Field work session for Airfield Pavement Inspection held at the Orlando Executive Airport

Chapter II

Distress in Jointed Rigid Pavement

1. BLOW UP
2. CORNNER BREAK
3. CRACKS, LONGITUDINAL, TREANSVERSE, AND DIAGONAL
4. DURABILITY “D” CRACKING
5. JOINT SEAL DAMAGE
6. PATCHING, SMALL
7. PATCHING LARGE AND UTILITY CUTS
8. POPOUTS
9. PUMPING
10. SCALLING
11. SETTLEMENT OR FAULTING
12. SHATTERED SLAB/INTERSECTING CRACKS
13. SHRINKAGE CRACKING
14. SPALLING (LONGITUDINAL AND TRANSVERSE JOINT)
15. SPALLING (CORNER)
16. ALKALIS SILICA REACTION (ASR)

Survey Data Sheet for Portland Cement Concrete (PCC) Pavement.



AIRFIELD CONCRETE PAVEMENTS

CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

BRANCH _____ SECTION _____ SAMPLE UNIT _____

SURVEYED BY _____ DATE _____ SAMPLE AREA _____

DISTRESS TYPES

61 BLOW UP
62 CORNER BREAK
63 LONG/TRANS/ DIAGONAL CRACK
64 DURABILITY CRACK
65 JOINT SEAL DAMAGE
66 PATCHING, < 5FT²
67 PATCHING/UTILITY CUT
68 POPOUTS
69 PUMPING
70 SCALING/MAP/CRACK CRAZING
71 SETTLEMENT/FAULT
72 SHATTERED SLAB
73 SHRINKAGE CRACK
74 SPALLING - JOINTS
75 SPALLING - CORNER

DIST TYPE	SEV	NO. SLABS	DENSITY %	DEDUCT VALUE
DEDUCT TOTAL				
CORRECTED DEDUCT VALUE (CDV)				

PCI = 100 - CDV = _____

RATING = _____

10 9 8 7 6 5 4 3 2 1

1 2 3 4

For Rigid Pavements, the severity levels for the following distresses are not defined:

1) POPOUTS

2) PUMPING

3) SHRINKAGE CRACKING

(Source: ASTM D5340/ AC 150/ 5380)

Classroom session for Airfield Pavement Inspection in Orlando

DISTRESS 1: **BLOW UP**

Description: Blowups occur in hot weather, usually at a transverse crack or joint that is not wide enough to permit expansion of the concrete slabs. The insufficient width is usually caused by infiltration of incompressible materials into the joint space. When expansion cannot relieve enough pressure, a localized upward movement of the slab edges (buckling) or shattering will occur in the vicinity of the joint. Blowups can also occur at utility cuts and drainage inlets. This type of distress is almost always repaired immediately because of severe damage potential to aircraft. Blowups are included for reference when closed sections are being evaluated for reopening

Location: Often, Blowup appears at a transverse crack or joint. Usually at the slab edges (buckling) or shattering will occur in the vicinity of the joint. However, Blowups can also be seen at utility cuts and drainage inlets.

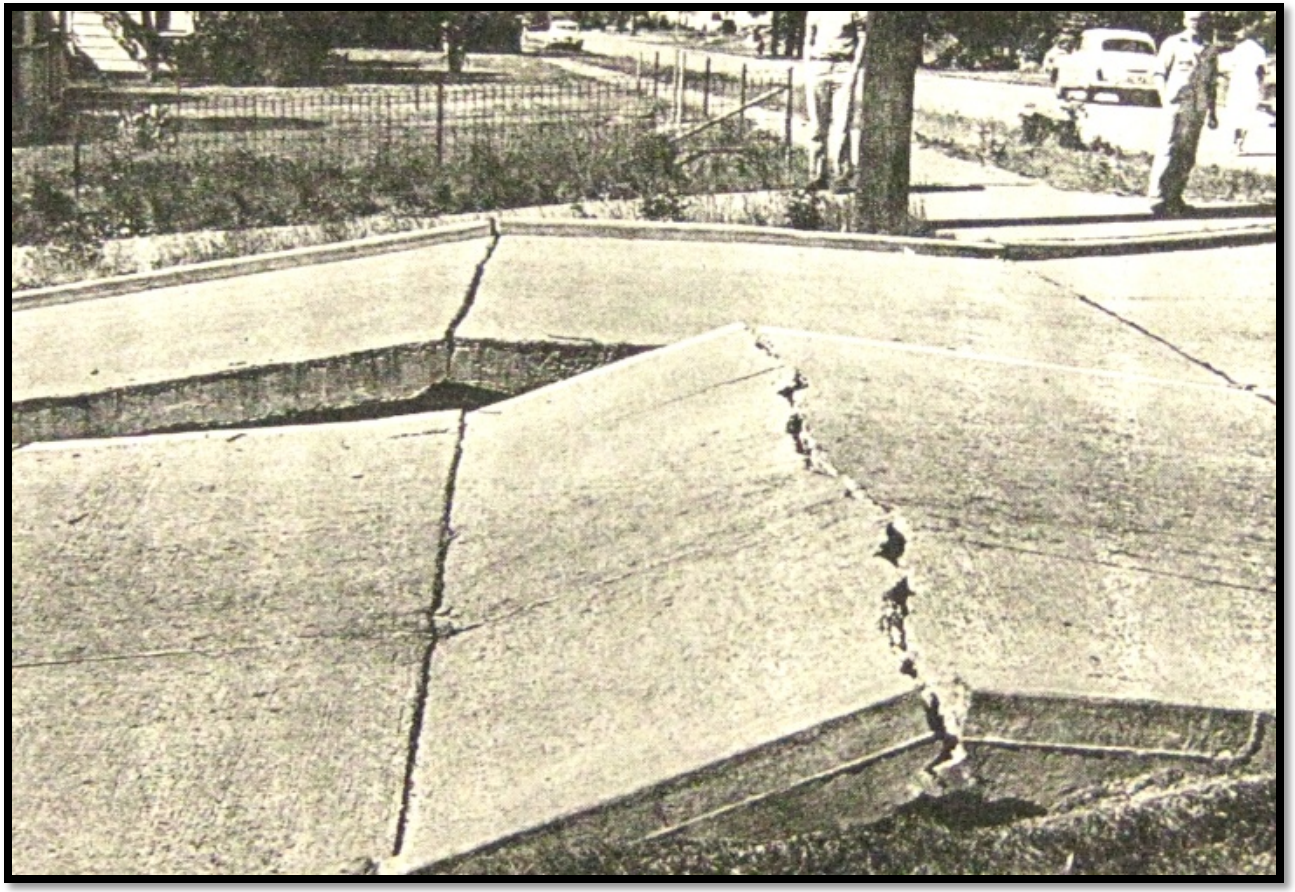
Causation: When expansion cannot relieve enough pressure, a localized upward movement of the slab edges (buckling) or shattering will occur in the vicinity of the joint. Also ASR.

Counting Procedure: A blowup usually occurs at a transverse crack or joint. At a crack, it is counted as being in one slab, but at a joint where two slabs are affected, the distress should be recorded as occurring in two slabs. Blowup can be recorded only if the distress has visually appeared on that slab. Severity may be different on adjacent slabs. If blowup has been repaired by patching, then its severity can be established by measuring the difference in elevation between the two slabs.

Severity Levels & Height Differential			
Severity	R/W & High-Speed Taxiways		Other
L	Buckling or shattering has not caused the pavement to be unusable, and only a slight amount of roughness exists.	< ½"	¼ < 1"
M	Buckling or shattering has not caused the pavement to be unusable, but a significant amount of roughness exists.	1/2 - 1"	1 – 2"
H	Buckling or shattering has rendered the pavement unusable		Unusable

Low Severity Blowup: A slight amount of roughness exists

Medium Severity Blowup: A significant amount of roughness exists



High Severity Blowup: The pavement is inoperable

Classroom session for Airfield Pavement Inspection in Orlando

DISTRESS 2: **CORNER BREAK**

Description: A corner break is a crack that intersects the joints at a distance less than or equal to one-half the slab length on both sides, measured from the corner of the slab. For example, a slab with dimensions of 25 by 25 feet (7.5 by 7.5 meters) that has a crack intersecting the joint 5 feet (1.5 meters) from the corner on one side and 17 feet (5.1 meters) on the other side is not considered a corner break; it is a diagonal crack. However, a crack that intersects 7 feet (2.1 meters) on one side and 10 feet (3 meters) on the other is considered a corner break. A corner break differs from a corner spall in that the crack extends vertically through the entire slab thickness, while a corner spall intersects the joint at an angle.

Location: Usually appear in the wheel path areas, such as runways and/or taxiways areas.

Causation: Load repetition combined with loss of support and curling stresses usually cause corner breaks. Curling stresses also cause corner breaks

Counting Procedure: The affected slab is recorded as one slab if it

- Contains a single corner break,
- Contains more than one break of a particular severity, or
- Contains two or more breaks of different severities.

For two or more breaks, the highest level of severity should be recorded. For example, a slab containing both light and medium severity corner breaks should be counted as one slab with a medium corner break.

SEVERITY SUMMARY TABLE				
Severity	**Non-Filled Cracks (M)**	**Filled Filler Condition**	**Filled or Non-Filled**	
			Spalling	**FOD**
L	General----- 1/ 2/Non-Filled, Mean <1/8” 3/ If Filled: (Any width) 4/ The area between -----	Can be Filled or Non-filled (1/8”= 0.13”) N/A Filer in satisfactory condition (**) --------the corner break and ------	Little or No N/A N/A ------the joints is ------	No N/A N/A -----not cracked
M	General: 1/ 2/Non Filled,Mean:1/8-1” 3/If Filled: (Any Width) 4/The area between ----	Can be Filled or Non-filled (between 0.13 – 1”) Filler is in unsatisfactory cond.--- ----the corner break and the ---	Moderately Little or No -- joints is slightly---	Some potential ------cracked (*).
H	General: 1/ 2/If Non-Filled, Mean:>1” 3/The area between	Can be Filled or Non-filled Creating a tire damage potential - the corner break and --	Severely N/A -the joints is severely	Definite Potential -----cracked

Notes: (*) **Slightly cracked** means 1 low-severity crack dividing the corner into two pieces
(**) **A crack filler is in satisfactory condition** if it prevents water and incompressible materials from entering the crack or joint.

Low Severity Corner Break: Little or no spalling, no FOD

Medium Severity Corner Break: Spalled, some FOD, dividing the corner into two pieces

High Severity Corner Break: Severely spalled with loose and missing particles

DISTRESS NO. 3: **LONGITUDINAL, TRANSVERSE AND DIAGONAL CRACKING**

Description These cracks, which divide the slab into two or three pieces, are usually caused by a combination of load repetition, curling stresses, and shrinkage stresses. (For slabs divided into four or more pieces, see Shattered Slab/Intersecting Cracks.) Low- severity cracks are usually warping- or friction-related and are not considered major structural distresses. Medium- or high-severity cracks are usually working cracks and are considered major structural distresses.

Location: LONGITUDINAL - Along the center line;
TRANSVERSE **-** Perpendicular to the center lines;
DIAGONAL CRACKS - Usually, around or near the corner area

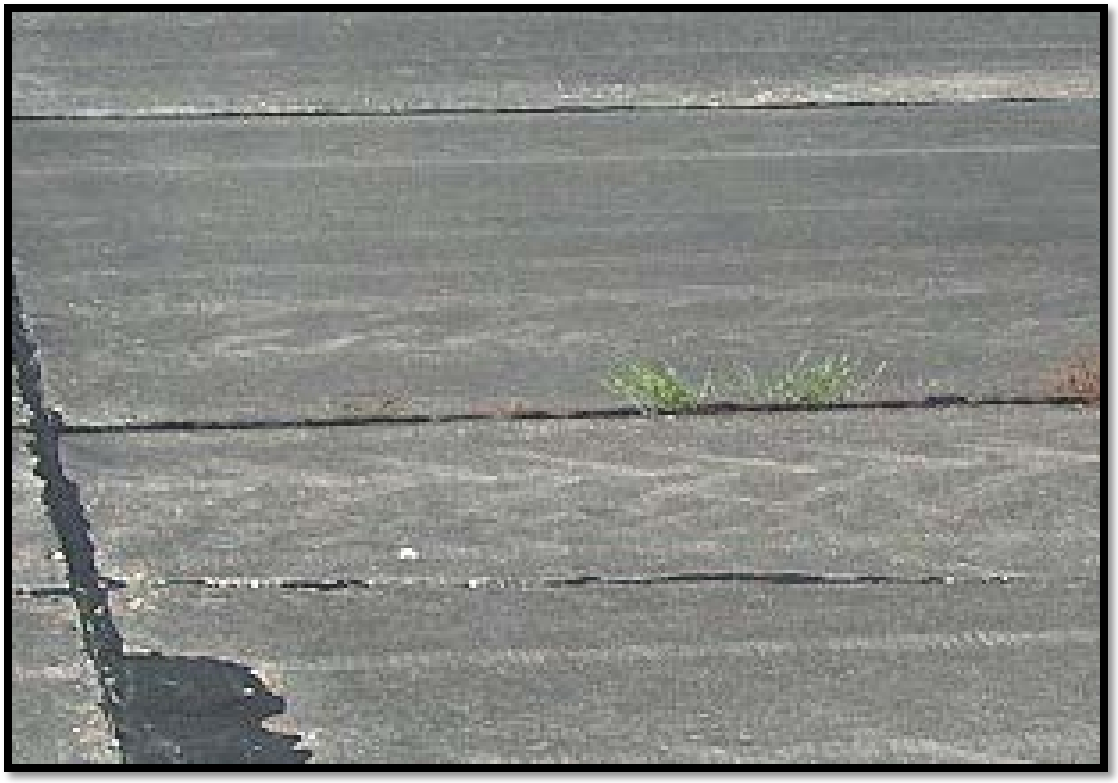
Causation: These cracks are usually caused by a combination of load repetition, curling stresses, and shrinkage stresses.

Counting Procedure: The distress is recorded as one slab once the severity has been identified.

SEVERITY SUMMARY TABLE				
Severity	**Non-Filled Cracks (M)**	**Filled Filler Condition**	**Filled or Non-Filled**	
			Spalling	**FOD**
L	General----- 1/ If N/F, Mean < 1/8” 2/ If Filled: Any width …….. 3/ The slab is divided ……	Crack has ---------- (<1/8” = 0.13”) .. Filler in Satisfactory condition ...into **3 pieces** by ……..	Little or No N/A **Low** severity-	No ---cracks.
M	General: 1/If Non filled, Mean: 1/8 -1” 2/ If Filled:…….. 3/The slab is divided into…	Can be Filled or Non-filled (between 0.13 – 1”) Filler is in unsatisfactory…… ….3 pieces by ≥2 cracks…….	Moderately Little or No ..with at least ---	Some potential …1 **Medium**.
H	(1)General: 2/ If Non-Filled, Mean: >1”…. 3/The slab is divided ……	Can be Filled or Non-filled Creating a tire damage…. ..into 3 pieces by ≥2 cracks ….	Severely potential with at least …..	Definite Potential 1 **High** severity

LONGITUDINAL CRACK

Low Severity Longitudinal Cracking: Has little or no spalling, no FOD



Medium Severity Longitudinal Cracking: Moderately spalled, some FOD

High Severity Longitudinal Cracking: Has a mean width approximately > 1”

TRANSVERSE CRACK

Low Severity Transverse Cracking: Has little or no spalling, no FOD

Medium Severity Transverse Cracking: Moderately spalled, some FOD

High Severity Transverse Cracking: Has a mean width approximately > 1”

DIAGONAL CRACKING

Low Severity Diagonal Cracking: Little or no spalling, no FOD

Medium Severity Diagonal Cracking: Spalled with some loose or missing particles. (FOD)

High Severity Diagonal Cracking: Three pieces by two or more cracks, high severity, heavy FOD

DISTRESS NO. 4: **DURABILITY or "D" CRACKING**

Description: Durability or "D" cracking is caused by the inability of the concrete to withstand environmental factors such as freeze-thaw cycles. It usually appears as a pattern of cracks running parallel to a joint or linear crack. A dark coloring can usually be seen around the fine durability cracks. This type of cracking may eventually lead to disintegration of the concrete within 1 to 2 feet (0.3 to 0.6 meter) of the joint or crack.

Location: It usually appears as a pattern of cracks running parallel to a joint or linear crack within 1 to 2 ft.

Causation: Durability cracking is caused by the concrete's inability to withstand environmental factors such as freeze-thaw cycles., and also by the loss of material around a joint or corner.

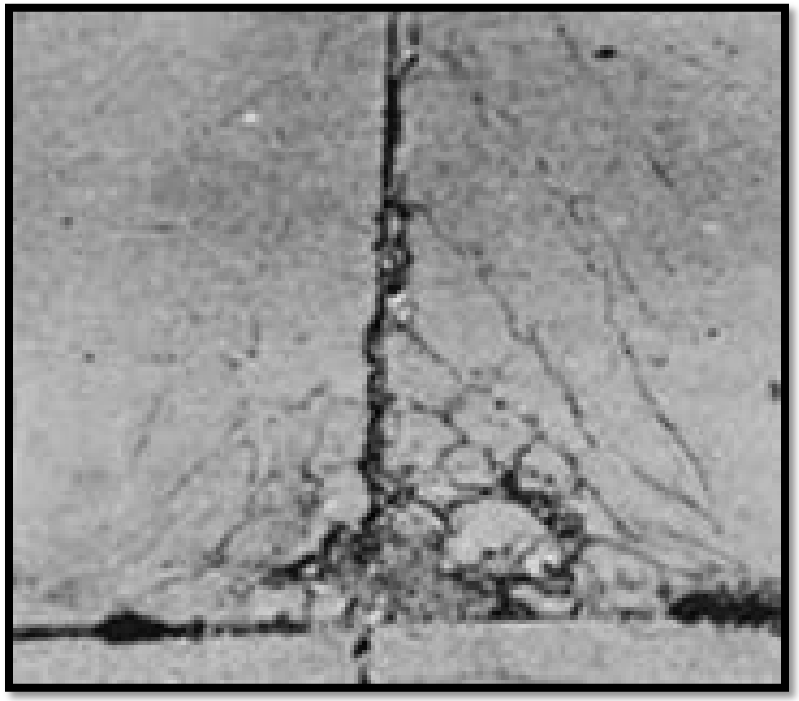
Counting Procedure: When the distress is located and rated at one severity, it is counted as one slab. If more than one severity level is found, the slab is counted as having the higher severity distress. For example, if light and medium durability cracking are located on one slab, the slab is counted as having medium only.

Notes: IF

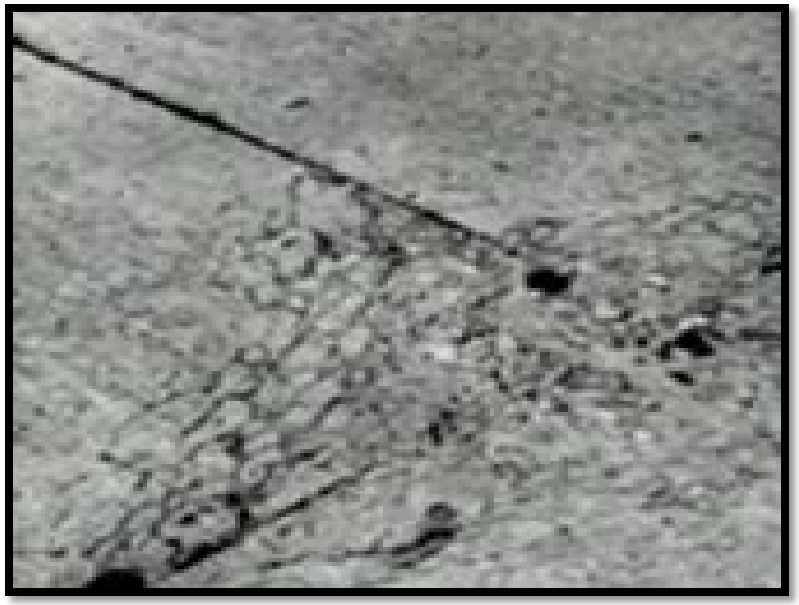
- "D" cracking is counted, scaling on the same slab should not be recorded.
- Corner or joint spalling caused by "D" cracking. Only "D" cracking should be recorded.

Severity	SEVERITY SUMMARY TABLE	FOD
L	"D" cracking is defined by hairline cracks occurring in a limited area of the slab, such as one or two corners or along one joint. Little or no disintegration has occurred.	**No**
M	(1) "D" cracking has developed over a considerable amount of slab area. (2) "D" cracking has occurred in a limited area of the slab, such as in one or two corners or along one joint, but pieces are missing and disintegration has occurred.	Little or No Some
H	"D" cracking has developed over a considerable amount of slab area with disintegration of FOD potential.	Yes

Low Severity D-Cracking: D-Cracking



Medium Severity D-Cracking: Occurring in limited area of slab



High Severity D-Cracking: D-Cracking (pieces are well defined and can be removed easily (some FOD)

DISTRESS NO. 5: **JOINT SEAL DAMAGE**

Description: Joint seal damage is any condition that enables soil or rocks to accumulate in the joints or allows significant infiltration of water.
Accumulation of incompressible materials prevents the slabs from expanding and may result in buckling, shattering, or spalling. Pliable joint filler bonded to the edges of the slabs protects the joints from accumulation of materials and also prevents water from seeping down and softening the foundation supporting the slab.

Location: At the joints between slabs.

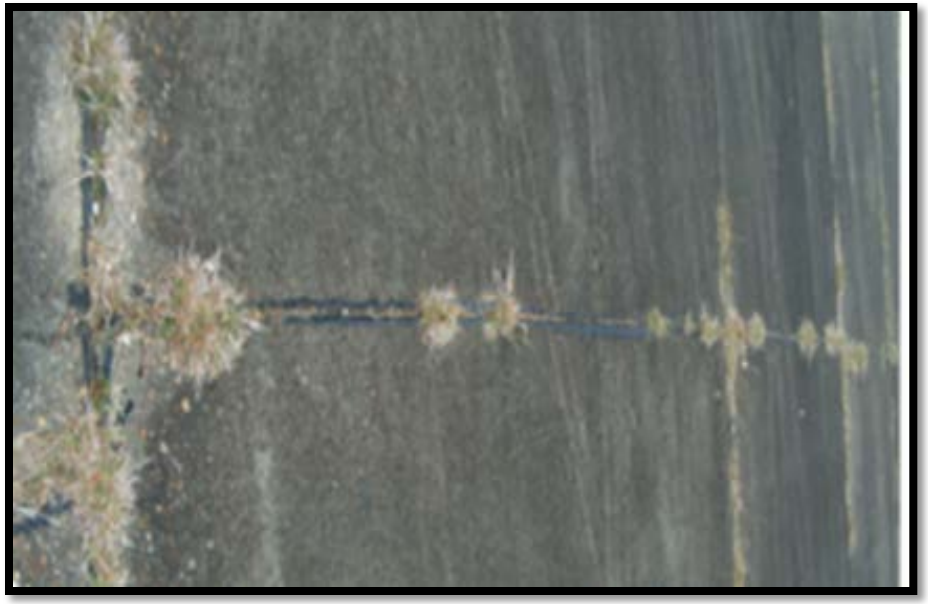
Causation: Accumulation of incompressible materials at the joints and joint sealant deterioration. Also, ASR.

Counting Procedure: Joint seal damage is not counted on a slab-by-slab basis, but it is rated based on the overall condition of the sealant over the entire sample unit.

ATTENTION: If more than 10% of the seal has been deformed but is still in place; rate its severity as low.

Severity	SEVERITY SUMMARY TABLE	Replacement
L	- Joint sealer is in generally good condition throughout the section. - Sealant is performing well, with only a minor amount of any of the above (6) types of damage present. Some joints have de-bonded but still in place.	NO
M	Joint sealer is in generally fair condition over throughout the section with one or more of the above (6) types of damage occurring to a **moderate degree**. **Few of the joints have any of the following conditions:** 1/ Sealer is in place but water access is possible thru visible openings with < 1/8 "wide. 2/ Pumping debris are evident at the joint. 3/ Joint sealer is oxidized & lifeless but pliable and generally fills the joint opening. 4/ Vegetation in the joint but does not interfere the joint opening.	< 2 years
H	1/ Joint sealer is in generally poor condition throughout the section, with one or more of the above types of damage occurring to a **severe degree**. **2/** If ≥10% of the joint sealer exceeds limiting condition listed above, or **3/ If ≥ 10%** sealer is missing**.**	Immediately

Low Severity Joint Seal Damage: 10% of the seal had been deformed but still in place



Medium Severity Joint Seal Damage: Joint sealer is in place but slightly damaged

High Severity Joint Seal Damage: Complete loss of sealant; joint is filled with incompressible material and heavily covered with vegetation

DISTRESS NO. 6: **PATCHING (SMALL LESS THAN 5 SQ FT)**

Description: A patch is an area where the original pavement has been removed and replaced by a filler material. For condition evaluation, patching is divided into two types: mall (less than 5 square feet (1.5 square meters)) and large (over 5 square feet (1.5 square meters)). Large patches are described in the next section.

Location: Where the original pavement has been removed and replaced.

Causation: Removal of the existing materials

Counting Procedure: If one or more small patches having the same severity level are located in a slab, it is counted as one slab containing that distress. If more than one severity level occurs, it is counted as one slab with the higher severity level being recorded. If a crack is repaired by a small patch (4 to 10" wide), only the crack and not the patch should be recorded at the appropriate severity level. If the original distress of a patch is more severe than the patch itself, the original distress type should be recorded.

Severity	SEVERITY SUMMARY TABLE	FOD
L	Patch is functioning well, with little or no deterioration	No
M	Patch has deteriorated, and/or moderated spalling can be seen. Some potential around the edges. Patch material can be dislodged (force out of place), with considerable effort.	Some potential
H	Patch has deteriorated to a state which causes considerable roughness and/or high FOD potential, or both. **The extent of the deterioration requires replacement of the patch.**	High potential

Low Severity Patching: Small patch; little or no deterioration

Medium Severity Patching: Small patch; moderate spalling

High Severity Patching: Small patch; spalling around the patch or cracking

DISTRESS NO. 7: **PATCHING (LARGE OVER 5 SQ FT AND UTILITY CUT)**

Description: Patching is the same as defined in the previous section. A utility cut is a patch that has replaced the original pavement because of placement of underground utilities.

The severity levels of a utility cut are the same as those for regular patching.

Location: Could be anywhere, especially around the joints.

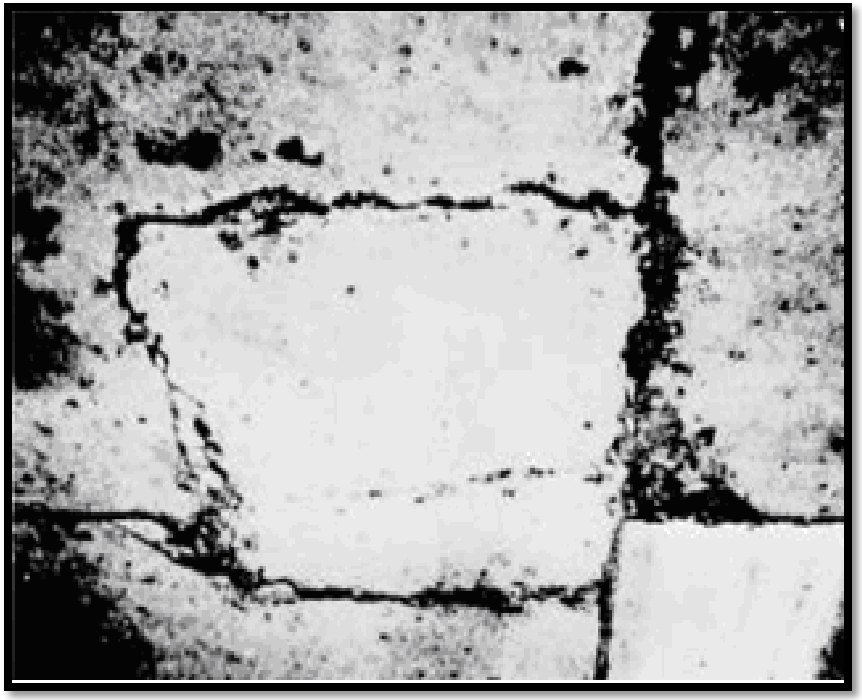
Causation: Removal of the existing materials

Counting Procedure: The criteria for counting are the same as for small patches.

Severity	SEVERITY SUMMARY TABLE	FOD
L	Patch is functioning well, with little or no deterioration	No
M	Patch has deteriorated, and/or moderated spalling can be seen. Some potential around the edges. Patch material can be dislodged (force out of place), with considerable effort.	Some potential
H	Patch has deteriorated to a state which causes considerable roughness and/or high FOD potential, or both. **The extent of the deterioration requires replacement of the patch.**	High potential

Low Severity Patching: Little or no deterioration

Medium Severity Patching: Deteriorated and/or some spalling



High Severity Patching: The extent of the deterioration warrants replacement of the patch

DISTRESS NO. 8: **POPOUTS**

Description: A popout is a small piece of pavement that breaks loose from the surface due to freeze-thaw action in combination with expansive aggregate. Popouts usually range from approximately 1 inch (25.4 millimeters) to 4 inches (102 millimeters) in diameter and from 1/2 inch (12.7 millimeters) to 2 inches (50.8 millimeters) deep.

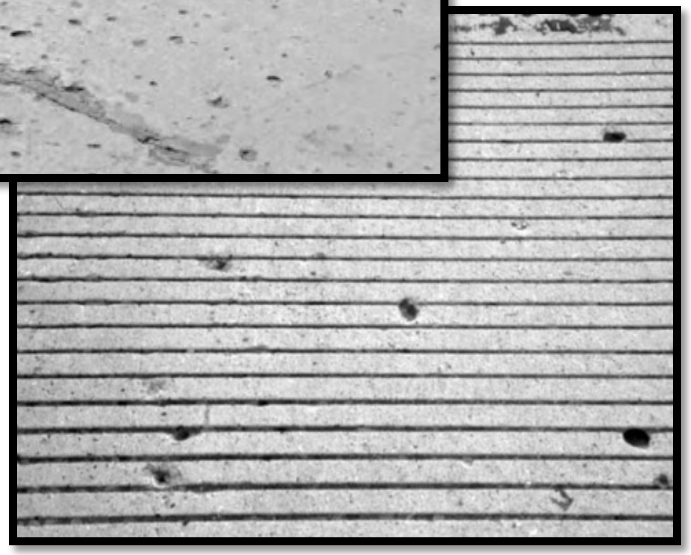
Location: Could be anywhere

Causation: Caused by freeze-thaw action in combination with expansive aggregates

Severity Levels: **No degrees of severity** are defined for popouts. However, pop outs must be extensive before they are counted as a distress; i.e., average popout density must exceed approximately three popouts per square yard over the entire slab area**.**

Counting Procedure: The density of the distress must be measured. If there is any doubt about the average being greater than three popouts per square yard, at least three random 1-sq-yd areas should be checked. When the average is greater than this density, the slab is counted.

Extensive pop-outs of large aggregate from surface.



Pop-out: **No degrees of severity**

DISTRESS NO. 9: **PUMPING**

Description: Pumping is the ejection of material by water through joints or cracks caused by deflection of the slab under passing loads. As the water is ejected, it carries particles of gravel, sand, clay, or silt and results in a progressive loss of pavement support. Surface staining and base or subgrade material on the pavement close to joints or cracks are evidence of pumping. Pumping near joints indicates poor joint sealer and loss of support that will lead to cracking under repeated loads

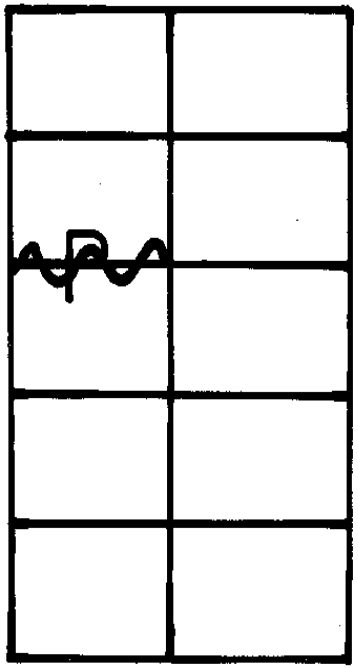
Location: Usually at the joints or cracks.

Causation: Caused by deflection of the slab under passing loads and also by poor joint sealer.

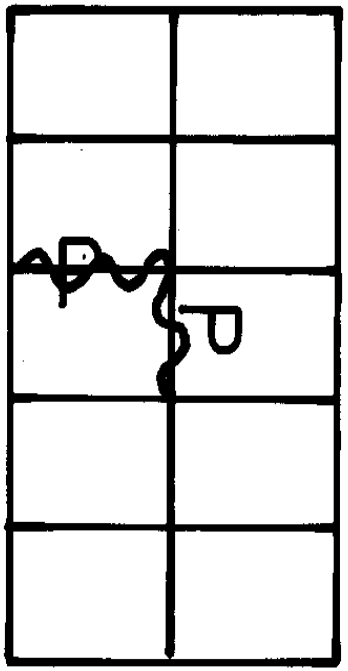
Severity Levels: **No degrees of severity are defined**. It is sufficient to indicate that pumping exists.

Counting Procedure: Slabs are counted as follows: one pumping joint between two slabs is counted as two slabs. However, if the remaining joints around the slab are also pumping, one slab is added per additional pumping joint. (See Slab Count for Pumping)

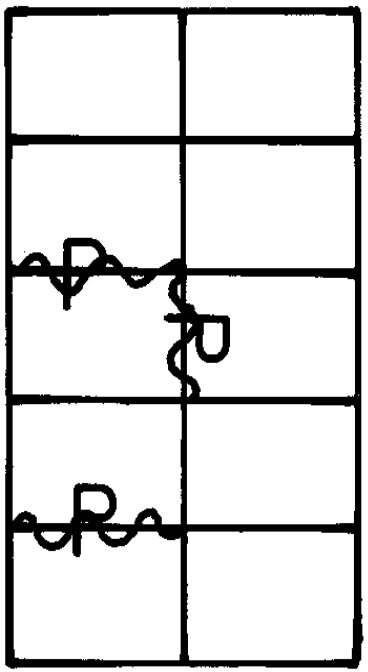
two slabs counted



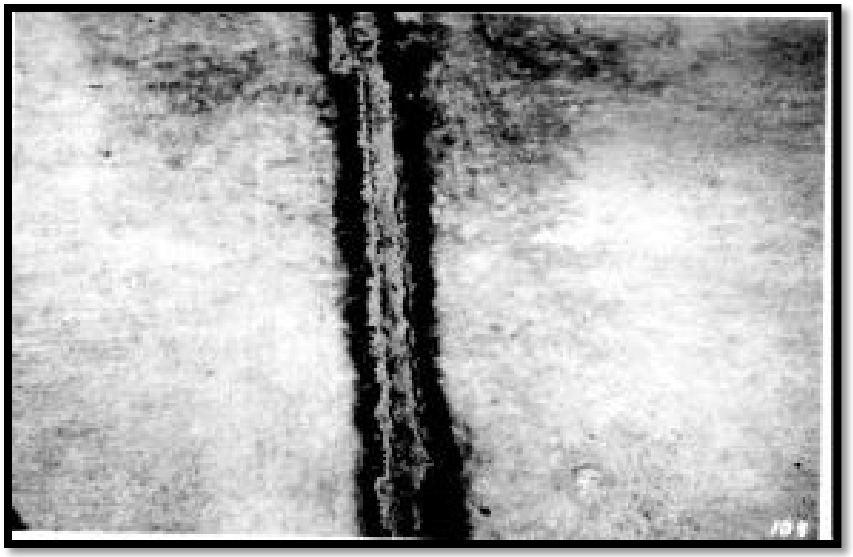
three slabs counted



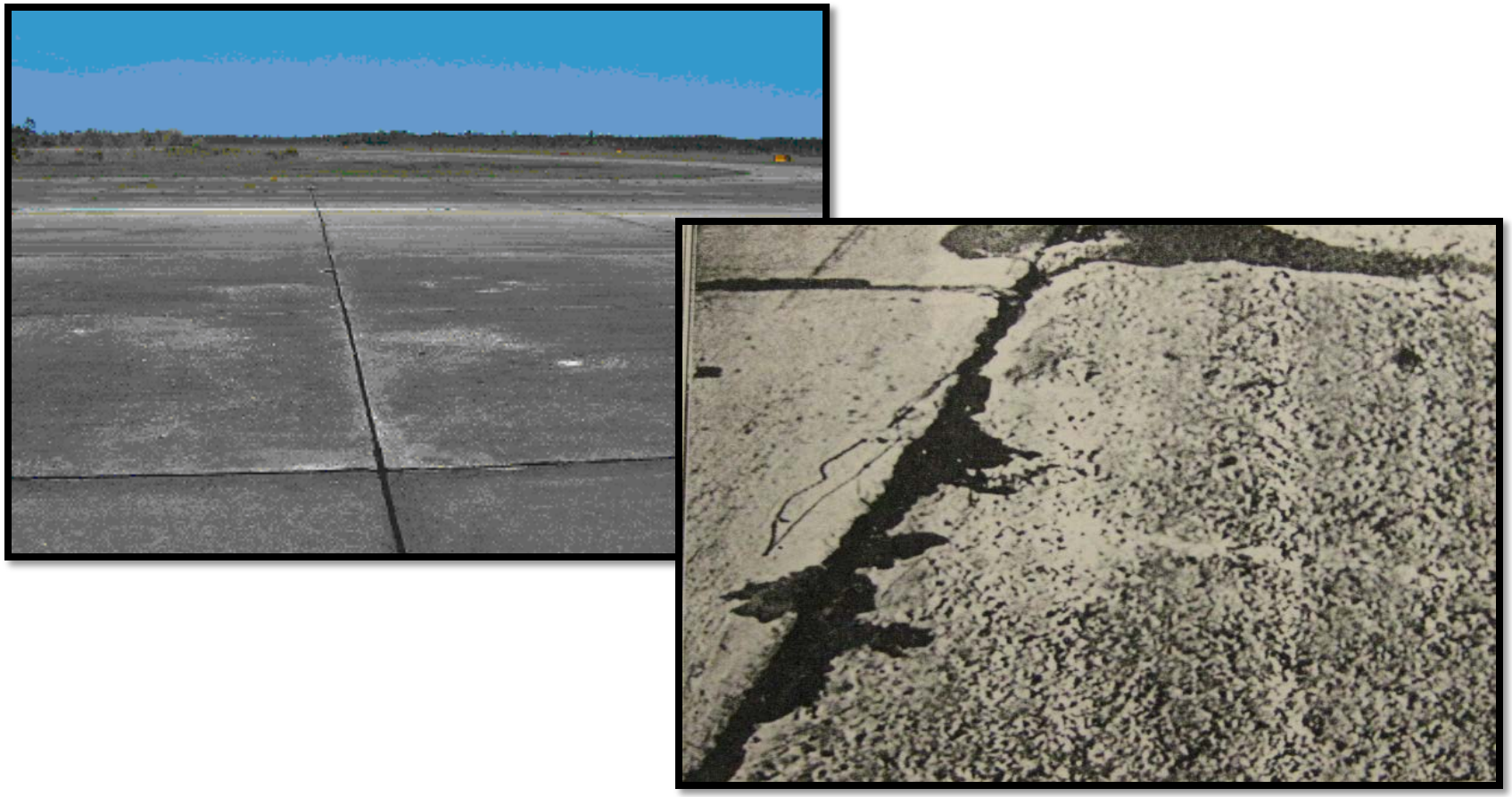
five slabs counted



Slab Count for Pumping



Pumping (note fine material on surface that has been pumped)



Pumping: **No degrees of severity** (Note stains on pavement)

DISTRESS NO. 10: SCALING

Description: Surface deterioration caused by construction defects, material defects and environmental factors. Generally scaling is exhibited by delaminating or disintegration of paste on the slab surface to the depth of the defect. Construction defects include over-finishing, addition of water to the pavement surface during finishing, lack of curing, attempted surface repairs of fresh concrete with mortar. Material defects include inadequate air entrainment for the climate. Environmental factors: freezing of concrete before adequate strength gained or thermal cycles from certain aircraft.

Location: For construction: a portion of a slab, for material defected: several slabs that were affected by the concrete batches for material defected, and for environmental factors: over a large area for freezing, and isolated areas for thermal effects.

Causation: Surface deterioration caused by construction defects, material defects and environmental factors. Deicing salts, improper construction, freeze-thaw cycles, and poor aggregate may also cause scaling.

Counting Procedure: If two or more levels of severity exist on a slab, the slab is counted as one slab having the maximum level of severity. For example, if both low-severity crazing and medium scaling exist on one slab, the slab is counted as one slab containing medium scaling.

Note: If "D" cracking is counted, scaling is not counted.

Severity	SEVERITY SUMMARY TABLE	% paste loss	FOD
L	Very little loss of surface paste.	< 1	No
M	There is some loss of surface pastes. Less than ¼ of the width of coarse aggregate. Coarse aggregate coming loose from the surface.	> 1 < 10	Some
H	The surface mortar becomes loose and routinely reappears despite the fact of removal.	> 10	High

FIG. X2.44 Low-Severity Scaling

FIG. X2.45 Medium-Severity Scaling

FIG. X2.47 Close-Up of High-Severity Scaling

High Severity Scaling: Severely scaled, amount of loose or missing material, more than 5% of the surface is affected

DISTRESS NO. 11: **SETTLEMENT OR FAULTING**

Description: Settlement or faulting is a difference of elevation at a joint or crack caused by upheaval or consolidation

Location: Usually at the joint areas.

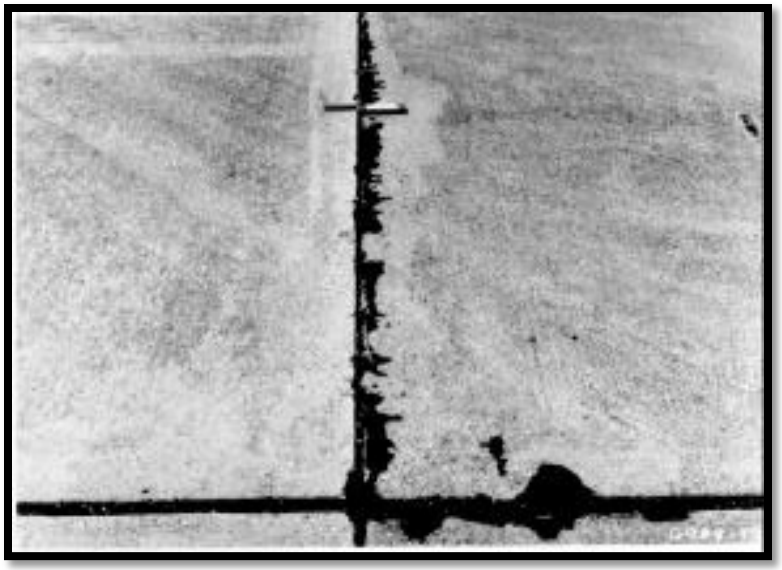
Causation: Settlement or fault could be caused by

- Soft foundation creates settlement;
- Deterioration under the slab such as creation of voids;
- Pumping of subgrade soils;
- The temperature and moisture change create the curling between the slab's edges;
- Caused by upheaval or consolidation; (vi) Heavy traffic can rapidly accelerate faulting; and,
- Joints may fault due to settlement of an adjacent slab.
- ASR

Severity Levels: Severity levels are defined by the difference in elevation across the fault and the associated decrease in ride quality and safety as severity increases.

Counting Procedure: In counting settlement, a fault between two slabs is counted as one slab**.** A straightedge or level should be used to aid in measuring the difference in elevation between the two slabs.

SEVERITY SUMMARY TABLE		
Severity	**Runway and T/W**	**Apron**
L	**< 1/4 in.**	**1/8 <1/2 in.**
M	**1/4 to 1/2**	**½ to 1 in.**
H	**> 1/2 in.**	**> 1 in.**



Low Severity Settlement: ¾” at the apron

Medium Severity Settlement: Settlement on apron > ½ inches

High Severity Settlement: Settlement on the Runway (inoperable)

DISTRESS NO. 12: **SHATTERED SLAB/INTERSECTING CRACKS**

Description: Intersecting cracks are cracks that break slab into four or more pieces due to overloading and/or inadequate support. The high-severity level of this distress type, as defined below, is referred to as a shattered slab. If all pieces or cracks are contained within a corner break, the distress is categorized as a severe corner break.

Location: At the slabs

Causation: Caused by overloading and/or inadequate support.

Counting Procedure:

- **I**f a slab is rated as medium or high severity level shattered slab, then no other distress type should be counted in the slab.

- **T**he deduct values for shattered slab distress are high since this condition is essentially failure; therefore, the counting of other distress types in the slab would tend to underrate the PCI of the sample unit.

- **S**hrinkage cracks should not be considered in deciding whether or not the slab is broken into 4 or more pieces.

Relationship between LTD, Intersecting Crack & Shattered Sla

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

Low Severity Shattered Slab/Intersecting Cracks: Slab is broken into four or five pieces

Medium Severity Shattered Slab/Intersecting Cracks: Slab is broken into four or five pieces with at least 5% or more cracks

High Severity Shattered Slab/Intersecting Cracks: Slab is broken into 6 or more pieces with over 15% cracks

DISTRESS NO. 13: SHRINKAGE CRACKING

Description: Shrinkage cracking is typically categorized in two forms: **DRYING SHRINKAGE** and **PLASTIC SHRINKAGE.**

DRYING SHRINKAGE that occurs over time as moisture leaves the pavement, they occur when a hardened pavement continues to shrink as excess water not needed for cement hydration evaporates. They form when subsurface resistance to the shrinkage is present and may extend through the entire depth of the slab.

PLASTIC SHRINKAGE that occurs shortly after the pavement is placed and rapid drying of the surface occurs while the pavement is still plastic. **PLASTIC SHRINKAGE** consists of two subcategories: **Plastic shrinkage** (caused by *atmosphere* such as high winds or low temperatures are contributing factors to evaporation), these cracks can appear as a series of parallel cracks, usually 1 to 3 feet apart and do not extend very deep into the pavement's surface; and **Plastic shrinkage** (caused by *construction*), these shrinkage cracks appear as a series of interconnected hairline cracks, or pattern cracking, and are often observed over a majority of the slab surface. This condition is also referred to as **Map cracking or Crazing**.

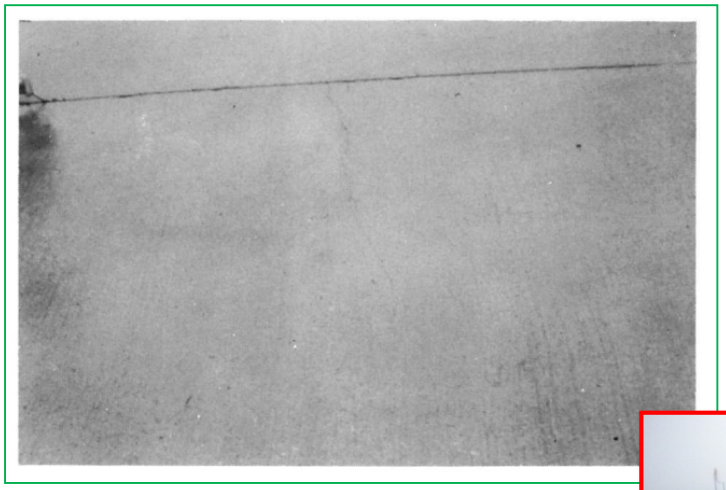
Location: Normally starts at the edge of slabs.

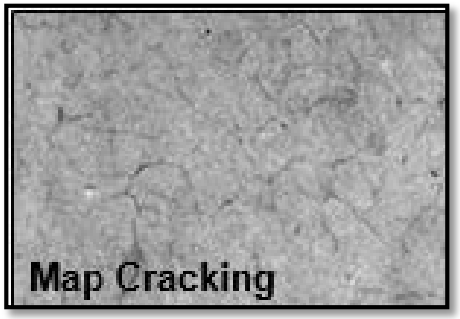
Causation: **Plastic shrinkage** formed during the setting and curing of the concrete and usually does not extend through the depth of the slab. Drying shrinkage cracks occur when a hardened pavement continues to shrink as excess water not needed for cement hydration evaporates. They form when subsurface resistance to the shrinkage is present and may extend through the entire depth of the slab.

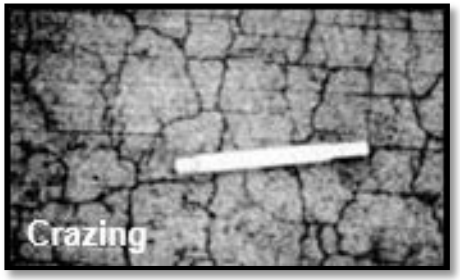
Severity Levels:

No degrees of severity are defined. It is sufficient to indicate that shrinkage cracking exists

Counting Procedure: If one or more shrinkage cracks or area of pattern cracking (map cracking) exist on one particular slab, and a FOD hazard or potential is not present, the slab is counted as one slab with shrinkage cracking.







Shrinkage Crack: Hairline cracks a few feet long, may extend through the entire depth of the slab

DISTRESS NO. 14: JOINT SPALLING (TRANSVERSE & LONGITUDINAL)

Description: Joint spalling is the breakdown of the slab edges within 2 feet (0.6 meter) of the side of the joint. A joint spall usually does not extend vertically through the slab but intersects the joint at an angle. Spalling results from excessive stresses at the joint or crack and it is caused by infiltration of incompressible materials or traffic loads. Weak concrete at the joint (caused by overworking) combined with traffic loads is another cause of spalling.

Location: Joint spalling can also occur along the edges of two adjacent slabs.

Causation: Spalling results from excessive stresses at the joint or crack caused by infiltration of incompressible materials or traffic load. The combination of the traffic load and weak concrete at the joint (caused by overworking) is another reason of spalling.

Attention: If less than 2 ft. of the joint is lightly frayed, the spall should not be counted.

Counting Procedure: If the joint spall is located along the edge of one slab, it is counted as one slab with joint spalling. If spalling is located on more than one edge of the same slab, the edge having the highest severity is counted and recorded as one slab. Joint spalling can also occur along the edges of two adjacent slabs. If this is the case, each slab is counted as having joint spalling.

Severity	SEVERITY SUMMARY TABLE			FOD….
L	**Spall over > 2 feet:** 1/ Spall is broken into ≤ 3 pieces… 2/ Joint is lightly frayed (*)……... **Spall < 2 feet:** Spall is broken into pieces or …….	defined by **Low** or **Medium** Severity.. …… fragmented. Little tire damage……..	…….. …… potential.	Little or No Little or No Little
M	**Spall over ≥ 2 feet:** 1/Spall is broken into > 3 pieces 2/Spall is broken into ≤ 3 pieces with… 3/Joint is moderately Frayed (**) ….. **Spall < 2 feet:** Spall is broken into pieces or …….. …..damage potential	….defined by **Light** or **Medium** cracks ..1 or more of the cracks being severe… ….with some…… ..fragmented with some of the pieces……	…with some potential of… ……..potential of…..…… ….loose or absent, causing ..	……FOD ……FOD .FOD or tire.
H	**Spall over > 2 feet:** 1/Spall is broken into >3 pieces…… and high possibility of the pieces… 2/Joint's severely frayed … **If Spall < 2 feet:** of the joint is……	defined by 1 or more **High-** severity …..cracks becoming dislodged, or …with **High**…….. ..lightly frayed, the Spall should not……	..with high potential of…… …….. ……..be counted.	….FOD FOD potential

(*) Lightly frayed means the upper edge of the joint is broken away leaving a spall no wider than 1 in. (25 mm) and no deeper than ½ in. (13 mm). The material is missing and the joint creates little or no FOD potential.

(**) Moderately frayed means the upper edge of the joint is broken away leaving a spall wider than 1 in. (25 mm) or deeper than ½ in. (13 mm). The material is mostly missing with some FOD potential.

Low Severity Joint Spalling: Less than 2 feet long, spall is broken into three pieces or less

Medium Severity Joint Spalling: Broken into pieces or fragmented with some FOD

High Severity Joint Spalling: Joint is severely frayed with a large amount of loose materials, badly FOD

DISTRESS NO. 15: **CORNER SPALLING**

Description: Corner spalling is the raveling or breakdown of the slab within approximately 2-feet (0.6-meter) of the corner. A corner spall differs from the corner break in that the spall angles downward to intersect the joint, while a break extends vertically through the slab.

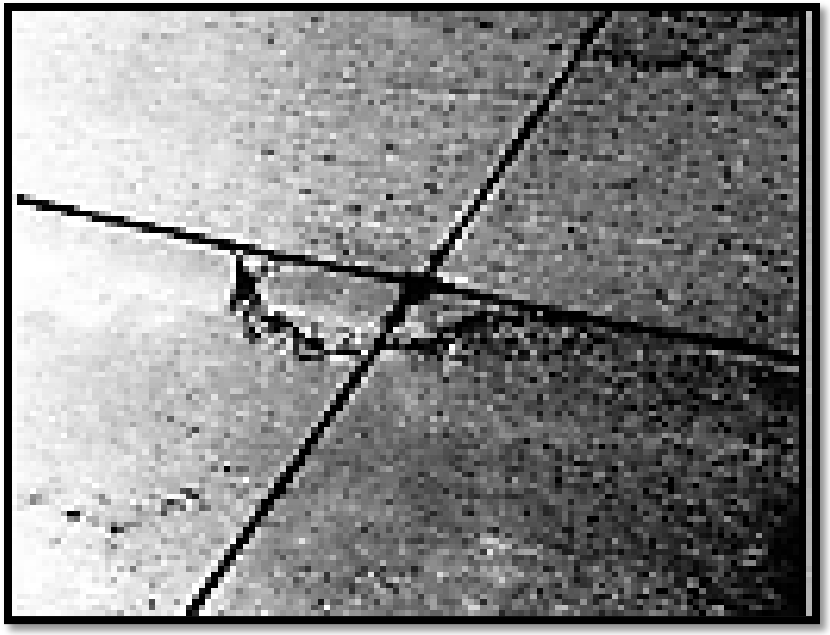
Location: Within approximately 2-feet (0.6-meter) of the corner.

Causation: Spalling results from excessive stresses at the joint or crack caused by infiltration of incompressible materials or traffic loads. Weak concrete at the joint (caused by overworking) combined with traffic loads is another cause of spalling.

Counting Procedure: If one or more corner spalls having the same severity level are located in a slab, the slab is counted as one slab with corner spalling. If more than one severity level occurs, it is counted as one slab having the higher severity level.

NOTE: A corner spall smaller than 3" wide, measured from the edge of the slab, and filled sealant is not recorded.

SEVERITY SUMMARY TABLE				
L	One of the following 1/ Spall is broken into 1 or 2 2/ Spall is defined by 1…….	conditions exists: pieces defined by **Low** severity… **Medium** severity level crack …..	 crack with little or No. . with some or None……	 …FOD ….FOD
M	One of the following 1/Spall is broken into > 2 pcs. 2/Spall is defined by one…… 3/Spall has deteriorated	conditions exists: .. defined by a **Med**. severity crack severe fragmented crack along .. to the point where loose material	 w/ some loose or absent ... a few hairline cracks. ..... is causing some…..	 .. pieces. …FOD
H	One of the following 1/Spall is broken into ≥ 2 ... with loose or absent … 2/ Pieces of the spall have … 3/Spall has deteriorated …..	conditions exists: pieces defined by **High** severity .. …fragments. been displaced to the extent that a to the point where loose material..	 …..fragmented crack(s)... tire damage potential….. ..is causing High FOD…	 …exists. potential .



Low Severity Corner Spalling

Medium Severity Corner Spalling

High Severity Corner Spalling: Heavily damaged; badly FOD

DISTRESS NO. 16: ALKALI SILICA REACTION (ASR)

Description: Alkali Silica Reaction is the reaction between the alkalis (Na2O and K2O) in some cement and certain minerals in some aggregates. Alkalis are most often introduced by the Portland cement within the pavement. ASR cracking may be accelerated by chemical pavement deicers.

Visual indicators that ASR may be present include cracking of the concrete pavement (often in a map pattern); white, brown, gray or other colored gel or staining may be present at the crack surface, aggregate popouts, and increase in concrete volume (expansion) that may result in distortion of adjacent or integral structures or physical elements.

Examples of expansion include shoving of asphalt pavements, light can tilting, slab faulting, joint misalignment, and extrusion of joint seals or expansion joint fillers.

Location: ASR is generally present throughout the section; coring and concrete petrographic analysis is a definitive method to confirm presence of ASR. Because ASR is material-dependent, ASR is generally present throughout the pavement section.

Causation: Chemical reaction between alkali and aggregates.

Counting Procedure: Number of slabs that are affected by the product. No other distresses should be recorded of the slab has a high severity level of ASR.

Severity	SEVERITY SUMMARY TABLE	FOD
L	Little or no evidence of movement in pavement or surrounding structures or elements.	Min. or No
M	May be evidence of slab movement; crack density increases, some fragments along cracks or at crack intersections, surface pop-outs of concrete may occur	increased FOD potential
H	One or both of the following exists: 1) loose of missing concrete fragments and 2) slab surface performance and function badly degraded, and it requires immediate repair.	High FOD potential

FIG. X2.74 Low-Severity ASR

FIG. X2.75 Medium-Severity ASR

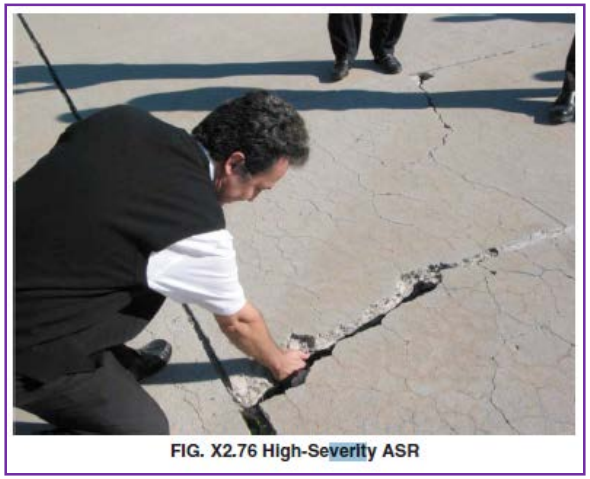


FIG. X2.76 High-Severity ASR

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.

Glossary

AC	Asphalt Concrete
ASTM	American Institute for Testing and Materials
FAA	Federal Aviation Administration
FAD	Florida Aviation Database
FDOT	Florida Department of Transportation
FOD	Foreign Object Damage
GPS	Global Positioning System
PCC	Portland cement Concrete
PCI	Pavement Condition Index
PMS	Pavement Management System
PMP	Statewide Pavement Management Program

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