CIVIL AVIATION GUIDANCE MATERIAL – 1410

PAVEMENT DISTRESS MANUAL

CIVIL AVIATION AUTHORITY OF MALAYSIA

ISSUE 01
REVISION 00 – 15TH MAY 2022

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Introduction

This Civil Aviation Guidance Material 1410 (CAGM – 1410) is issued by the Civil Aviation Authority of Malaysia (CAAM) to provide guidance for Aerodrome Operator on the manual of pavement distress, pursuant to Civil Aviation Directive 14 Volume I – Aerodromes Design and Operations (CAD 14 Vol I).

Organisations may use these guidelines to demonstrate compliance with the provisions of the relevant CAD's issued. Without prejudice to Regulation 204 and Regulation 205 of the Malaysian Civil Aviation Regulations 2016 (MCAR 2016), when the CAGMs issued by the CAAM are used, the related requirements of the CAD's are considered as met, and further demonstration may not be required.

(Datuk Captain Chester Voo Chee Soon)
Chief Executive Officer
Civil Aviation Authority of Malaysia

Civil Aviation Guidance Material components and Editorial practices

This Civil Aviation Guidance Material is made up of the following components and are defined as follows:

Standards: Usually preceded by words such as *"shall"* or *"must"*, are any specification for physical characteristics, configuration, performance, personnel or procedure, where uniform application is necessary for the safety or regularity of air navigation and to which Operators must conform. In the event of impossibility of compliance, notification to the CAAM is compulsory.

Recommended Practices: Usually preceded by the words such as "*should"* or "*may*", are any specification for physical characteristics, configuration, performance, personnel or procedure, where the uniform application is desirable in the interest of safety, regularity or efficiency of air navigation, and to which Operators will endeavour to conform.

Appendices: Material grouped separately for convenience but forms part of the Standards and Recommended Practices stipulated by the CAAM.

Definitions: Terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have an independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

Tables and Figures: These add to or illustrate a Standard or Recommended Practice and which are referred to therein, form part of the associated Standard or Recommended Practice and have the same status.

Notes: Included in the text, where appropriate, Notes give factual information or references bearing on the Standards or Recommended Practices in question but not constituting part of the Standards or Recommended Practices;

Attachments: Material supplementary to the Standards and Recommended Practices or included as a guide to their application.

The units of measurement used in this CAGM are in accordance with the International System of Units (SI) as specified in CAD 5. Where CAD 5 permits the use of non-SI alternative units, these are shown in parentheses following the basic units. Where two sets of units are quoted it must not be assumed that the pairs of values are equal and interchangeable. It may, however, be inferred that an equivalent level of safety is achieved when either set of units is used exclusively.

Any reference to a portion of this document, which is identified by a number and/or title, includes all subdivisions of that portion.

Throughout this Civil Aviation Guidance Material, the use of the male gender should be understood to include male and female persons.

Record of revisions

Revisions to this CAGM shall be made by authorised personnel only. After inserting the revision, enter the required data in the revision sheet below. The *'Initials'* has to be signed off by the personnel responsible for the change.

Rev No.	Revision Date	Revision Details	Initials

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Summary of Changes

ISS/REV no.	Item no.	Revision Details

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1 General

1.1 Introduction

1.1.1 This guidance material aims to provide guidance to the aerodrome operator on the evaluation of pavement distress.

1.1.2 The Authority shall be satisfied that the aerodrome conforms with this Guidance, and that the aerodrome will offer a safe environment for the operations of the aircrafts that it is intended for and that the aerodrome operator has the necessary competence and experience to operate and maintain the aerodrome.

1.2 Applicability

1.2.1 This Guidance is applicable and prescribes the manual for the types of pavement distress, in accordance with CAD 14 Volume I.

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2 Pavement Distress

2.1 Types of Pavement Distress

2.1.1 The following types of distress commonly occur in flexible and rigid pavements.

No	Flexible pavement	Rigid Pavement
1.	Alligator Cracking	Blow Up
2.	Block Cracking	Corner Break
3.	Longitudinal and Transverse Cracking	Longitudinal, Transverse and Diagonal Cracking
4.	Corrugation	Durability (“D) Cracking
5.	Depression	Joint Seal Damage
6.	Rutting	Pop Outs
7.	Shoving	Pumping
8.	Bleeding	Scaling, Map Cracking, Crazing
9.	Polished Aggregate	Settlement or faulting
10.	Ravelling and Weathering	Spalling
11.	Patching and Utility Cut Patching	
12.	Slippage Cracking	
13.	Swell	
14.	Pothole	

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3 Flexible Pavement Distresses

3.1 Illustration and distresses severity

3.1.1 Alligator Cracking

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Alligator Cracking</td><td>Alligator cracking may be considered a combination of fatigue and block cracking. It is a series of interconnected cracks of various stages of development. Alligator cracking develops into a many-sided pattern that resembles chicken wire or alligator skin. It can occur anywhere in the road lane. Alligator cracking must have a quantifiable area.

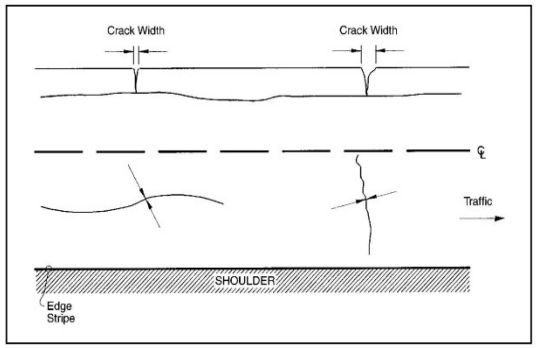
Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>CRACK WIDTH</td><td>Less than 6mm</td><td>6mm to 19mm</td><td>More than 19mm</td></tr>
<tr><td>CRACK PATTERN</td><td>Fine, longitudinal hairline crack run parallel with none/few interconnecting cracks. Not spalled</td><td>Well defined of pattern interconnecting crack which securely held. Lightly spalled</td><td>Pieces are well defined (loosen) and spalled at edges. Potential FOD</td></tr>
</table>
How to measure the severity: -
Measured in the gap of the cracks in millimetres and area affected in meters.</td><td> 

Figure 1a: Measuring Crack Width on Asphalt Pavement

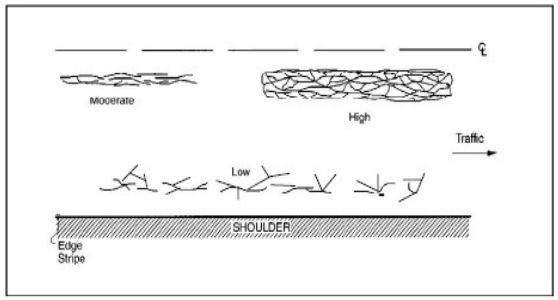
 

Figure 1b: Alligator Crack Patterns of Differing Severity</td></tr>
</table>

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
	Recommended action to be taken: - Low - Take note of the distress existence Medium - Close monitoring and arrange for repair works if it occurs on the wheel path High - Arrange for repair works	 **Figure 1c: Alligator Crack with Medium Severity**  **Figure 1d: Alligator Crack with High Severity**

3.1.2 Block Cracking

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Block Cracking</td><td>
Pattern of cracks that divide the pavement into approximately rectangular pieces. Rectangular blocks range in size from approximately 0.3m x 0.3m to 3m x 3m.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>CRACK WIDTH</td><td>Less than 6mm</td><td>6mm to 19mm</td><td>More than 19mm</td></tr>
<tr><td>CRACK PATTERN</td><td>Non or lightly spalled cracks or filled cracks with sealant material in good condition</td><td>Filled or non filled cracks with potential or minor FOD</td><td>Blocks are well defined by severely spalled cracks causing definite FOD</td></tr>
</table>
How to measure the severity: -
Measured in the gap of the cracks in millimetres and area affected in meters.

Recommended action to be taken: -
Low - Take note of the distress existence

Medium - Close monitoring

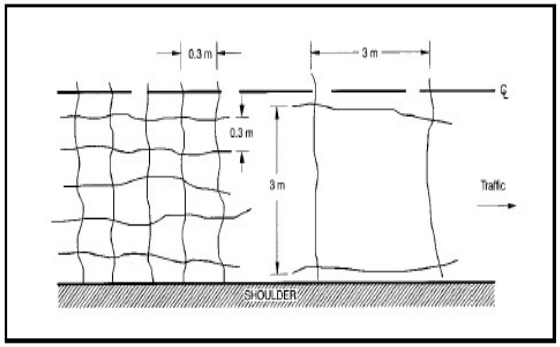
High - Arrange for repair works
</td><td>


Figure 3a: Block Cracking


Figure 3b: Block Cracking with Medium Severity
</td></tr>
</table>

3.1.3 Longitudinal/Transverse Cracking

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr>
<td>Longitudinal/ Transverse Cracking</td>
<td>
Longitudinal cracking occurs predominantly parallel to the pavement centreline. It can occur anywhere within the lane. Longitudinal cracks occurring in the wheel path may be significant.

Transverse cracking occurs predominantly perpendicular to the pavement centreline. It can occur anywhere within the lane.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>CRACK WIDTH</td><td>Less than 6mm</td><td>6mm to 19mm</td><td>More than 19mm</td></tr>
<tr><td>CRACK PATTERN</td><td>Light spalling with less or no potential FOD</td><td>Moderate spalled with FOD potential</td><td>Multiple spalling and pieces are loosen or missing causing definite FOD</td></tr>
</table>
How to measure the severity: -
Measured in the gap of the cracks in millimetres and length of the crack in meters.

Recommended action to be taken: -
Low - Take note of the distress existence

Medium - Close monitoring and arrange for repair works if it occurs on the wheel path
</td>
<td>


Figure 6a: Longitudinal Cracking
</td>
</tr>
</table>

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
	High - Arrange for repair works	 **Figure 6b: Transverse Cracking**

3.1.4 Corrugation

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Corrugation</td><td>
A series of closely spaced ridges and valleys occurring at fairly regular intervals (less than 1.5m) along the pavement. The ridges are perpendicular to the traffic direction.

Severity Levels
<table>
<tr><th colspan="2"></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td rowspan="2">DEPTH OF THE VALLEYS</td><td>RWY & High-Speed TWY</td><td>Less than 6mm</td><td>6mm to 13mm</td><td>More than 13mm</td></tr>
<tr><td>Other areas</td><td>Less than 13mm</td><td>13mm to 25mm</td><td>More than 25mm</td></tr>
<tr><td colspan="2">PATTERN</td><td>Minor pattern and do not significantly affect ride quality</td><td>Noticeable and significantly affect ride quality</td><td>Easily notice and severely affect ride quality</td></tr>
</table>
How to measure the severity: -
Measured the depth of the valleys by using a 3m straightedge, place perpendicular to the corrugations.

Recommended action to be taken: -

Low - Take note of the distress existence
</td><td>

Figure 4: Corrugation
</td></tr>
</table>

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
	Medium - Arrange for repair works if occurred on runway or high-speed taxiway. Close monitoring at other areas High - Arrange for repair works	

3.1.5 Depression

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Depression</td><td>Localized pavement surface areas having elevations slightly lower than the surrounding pavement. Creates water ponding and stains caused by the ponding water.

Severity Levels
<table>
<tr><th colspan="2"></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td rowspan="2">DEPTH OF THE DEPRESSIONS</td><td>RWY & High-Speed TWY</td><td>3mm to 13mm</td><td>13mm to 25mm</td><td>More than 25mm</td></tr>
<tr><td>Other areas</td><td>13mm to 25mm</td><td>25mm to 51mm</td><td>More than 51mm</td></tr>
<tr><td colspan="2">PATTERN</td><td>Observed or located by the stain areas, lightly affect rice quality and may cause hydroplaning potential on runway</td><td>Can be observed, moderately affect rice quality and may cause hydroplaning potential on runway</td><td>Can be observed, severely affect rice quality and cause definite hydroplaning potential on runway</td></tr>
</table></td><td> 
Figure 5: Water ponding due to Depression</td></tr>
</table>

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
	How to measure the severity: - Measured the depth of the depressions by using a 3m straightedge, place across the depression area, measure the maximum depth of the depression and area affected in meters. **Recommended action to be taken: -** Low - Take note of the distress existence Medium - Arrange for repair works High - Arrange for repair works ***Any depression more than 3mm depth with an area of more than 1sq.m at runway and high-speed area shall be repaired immediately***	

3.1.6 Rutting

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr>
<td>Rutting</td>
<td>
Rutting is a longitudinal surface depression in the wheel path.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>RUT DEPTH</td><td>Less than 13mm</td><td>13mm to 25mm</td><td>More than 25mm</td></tr>
</table>

How to measure the severity: -
Measured the depth of the rutting by using a 3m straightedge, place across the rut area and measure the maximum depth of the depression.

Recommended action to be taken: -

Low - Take note of the distress existence

Medium - Close monitoring

High - Arrange for repair works

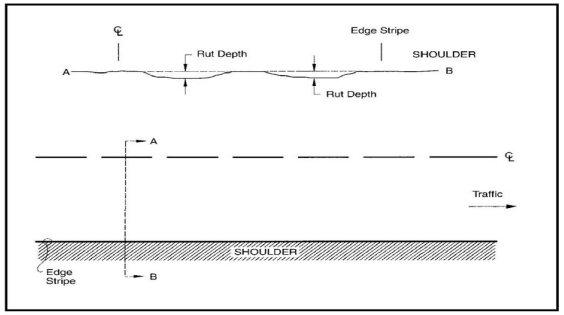
*Any depression more than 3mm depth with an area of more than 1sq.m at the runway and high-speed area shall be repaired immediately.
</td>
<td>


Figure 10a: Rutting


Figure 10b: Rutting on pavement
</td>
</tr>
</table>

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
		 **Figure 10c: Water ponding due to Rutting**

3.1.7 Shoving (Caused by Pavement Quality Concrete (PQC) Slabs)

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Shoving
(Caused by PQC Slabs)</td><td>
Occurs when the asphalt concrete pavement adjoins with PQC pavement. The PQC pavement may occasionally increase in length and it shoves the asphalt concrete pavement, causing them to swell and crack.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>PATTERN</td><td>A slight amount of shoving has occurred and no breakup of the asphalt pavement</td><td>A significant amount of shoving has occurred, causing moderate roughness and little or no breakup of the asphalt pavement</td><td>A large amount of shoving has occurred, causing severe roughness and breakup of the asphalt pavement</td></tr>
</table>
How to measure the severity: -
Observe the condition of the shoving based on the pattern.

Recommended action to be taken: -
Low - Take note of the distress existence

Medium - Arrange for repair works if occurred on runway or high-speed taxiway. Close monitoring at other areas

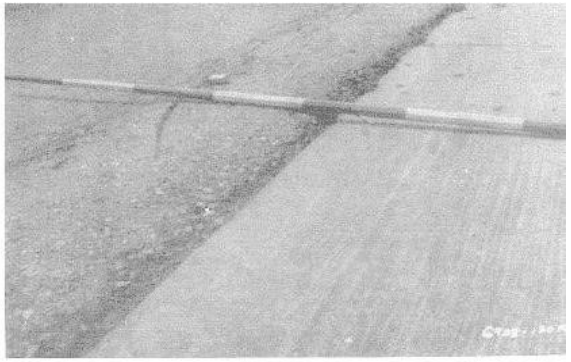
High - Arrange for repair works
</td><td>


Figure 11: Shoving
</td></tr>
</table>

3.1.8 Bleeding

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr>
<td>Bleeding</td>
<td>
A film of bituminous material on the pavement surface that creates a shiny, glasslike, reflecting surface that usually becomes quite sticky caused by excessive amounts of asphaltic cements.

Severity Levels
<table>
<tr><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>Asphalt does not stick to shoes or vehicles</td><td>Asphalt stick to shoes or vehicles</td><td>Asphalt stick to shoes or vehicles extensively</td></tr>
</table>
How to measure the severity: -
Measured in the square meters of surface area.

Recommended action to be taken: -
Low - Take note of the distress existence

Medium - Close monitoring

High - Arrange for repair works
</td>
<td>


Figure 2: Bleeding
</td>
</tr>
</table>

3.1.9 Polished Aggregates

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
Polished Aggregates	Surface binder worn away to expose coarse aggregate or no rough or angular aggregate particles to provide skid resistance. **Severity Levels** Not applicable. However, the degree of polishing may be reflected in a reduction of surface friction and the aggregate should be smooth to touch. **Recommended action to be taken: -** Take note of the distress existence and arrange for repair works if the surface friction gives value lower than Maintenance Planning Level (MPL – based on the Grip Tester result).	 **Figure 8: Expose coarse aggregate**

3.1.10 Ravelling and Weathering

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr>
<td>Ravelling and Weathering</td>
<td>
Wearing away of the pavement surface caused by the dislodging of aggregate particles and loss of asphalt binder. Ravelling ranges from loss of fines to loss of some coarse aggregate and ultimately to a very rough and pitted surface with obvious loss of aggregate.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>MEASUREMENT</td><td>Aggregate coarse exposed ¼ of its diameter</td><td>Aggregate coarse exposed ½ of its diameter</td><td>The top layer of aggregate coarse has eroded away</td></tr>
<tr><td>PATTERN</td><td>Aggregate or binder has started to wear away. Lightly or no FOD potential</td><td>Aggregate or binder, or both has worn away. Moderate FOD potential. Surface texture is moderately rough and pitted.</td><td>Aggregate or binder, or both has worn away. High FOD potential. Surface texture is severely rough and pitted.</td></tr>
</table>
How to measure the severity: -
Observe the ride quality and the condition of the patch.
</td>
<td>


Figure 9: Ravelling
</td>
</tr>
</table>

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
	Recommended action to be taken: - Low - Take note of the distress existence Medium - Arrange for repair works if occurred on runway or high-speed taxiway. Close monitoring at other areas High - Arrange for repair works	

3.1.11 Patching

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Patching</td><td>
Patching is an area of pavement surface that has been removed and replaced with patching material or an area of pavement surface that has had additional patching material applied.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>PATTERN</td><td>Patch in good condition and performing satisfactorily</td><td>Patch deteriorated and affect ride quality</td><td>Patch need replacement and cause FOD potential</td></tr>
</table>

How to measure the severity: -
Observe the ride quality and the condition of the patch.

Recommended action to be taken: -
Low - Take note of the distress existence

Medium - Arrange for repair works if occurred on runway or high-speed taxiway. Close monitoring at other areas

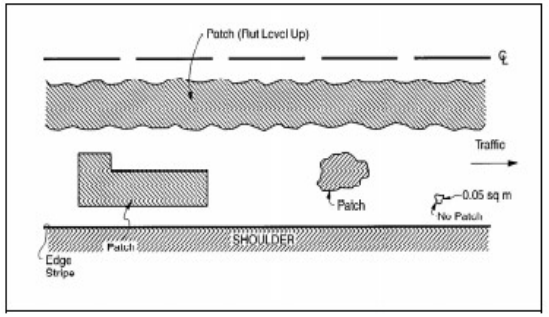
High - Arrange for repair works
</td><td>


Figure 7: Patching Variations
</td></tr>
</table>

3.1.12 Slippage Cracking

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Slippage Cracking</td><td>
Crescent or half-moon shaped cracks having two ends pointed away from the direction of traffic. Produced when braking or turning wheels cause the pavement surface to slide or deform.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>PATTERN</td><td>Cracks with no break-up</td><td>Cracks with some break-up and FOD potential</td><td>Cracks with considerable break-up and missing causing definite FOD</td></tr>
</table>
How to measure the severity: -
Observe the existence of the slippage cracking. Measured in the gap of the cracks in millimetres and area affected in meters.

Recommended action to be taken: -
Low - Take note of the distress existence

Medium - Arrange for repair works if occurred on runway or high-speed taxiway. Close monitoring at other areas

High - Arrange for repair works
</td><td>

Figure 12: Slippage Cracking
</td></tr>
</table>

3.1.13 Swell Distress

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Swell Distress</td><td>
Characterized by an upward bulge in the pavement surface. May occur sharply over a small area or as a longer, gradual wave.

Severity Levels
<table>
<tr><th colspan="2"></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td rowspan="2">MEASUREMENT</td><td>RWY & High-Speed TWY</td><td>Less than 19mm</td><td>19mm to 37.5mm</td><td>More than 37.5mm</td></tr>
<tr><td>Other areas</td><td>Less than 38mm</td><td>38mm to 75mm</td><td>More than 75mm</td></tr>
<tr><td colspan="2">PATTERN</td><td>Barely visible and has minor effect on pavement ride quality</td><td>Visible and has significant effect on pavement ride quality</td><td>Obviously visible and severely affect the pavement ride quality</td></tr>
</table>
How to measure the severity: -
Observe the ride quality and the condition of the swell. The measurement can be taken using the 3m straightedge, place on the highest point of the swell and measure the height differential above the pavement.

Recommended action to be taken: -
Low - Take note of the distress existence
Medium - Arrange for repair works if occurred on runway or high-speed taxiway. Close monitoring at other areas
High - Arrange for repair works
</td><td>

Figure 13: Swell Distress
</td></tr>
</table>

3.1.14 Potholes

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Potholes</td><td>
Potholes are bowl-shaped holes of various sizes occurring in the pavement surface.

Severity Levels (Runway and Taxiway)
There are no stratified severities for potholes. They either are present or they are not and must not be allowed on any aircraft manoeuvring and movement areas.

Severity Levels (Road)
<table>
<tr><th rowspan="2">DEPTH (mm)</th><th colspan="3">AVERAGE DIAMETER (mm)</th></tr>
<tr><th>102 – 203</th><th>203 – 457</th><th>More than 457</th></tr>
<tr><td>127 – 254</td><td>L</td><td>L</td><td>M</td></tr>
<tr><td>254 – 508</td><td>L</td><td>M</td><td>H</td></tr>
<tr><td>More than 508</td><td>M</td><td>M</td><td>H</td></tr>
</table>
Recommended action to be taken: -

Runway/Taxiway/Apron - Arrange for immediate repair works

Road - Arrange for immediate repair works if it occurs on the heavy movement area
</td><td>


Figure 14: Potholes
</td></tr>
</table>

4 Rigid Pavement Distresses

4.1 Illustration and distresses severity

4.1.1 Blow Up

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Blow Up</td><td>Localized upward movement of the pavement surface at transverse joints or cracks, often accompanied by shattering of the concrete in that area.

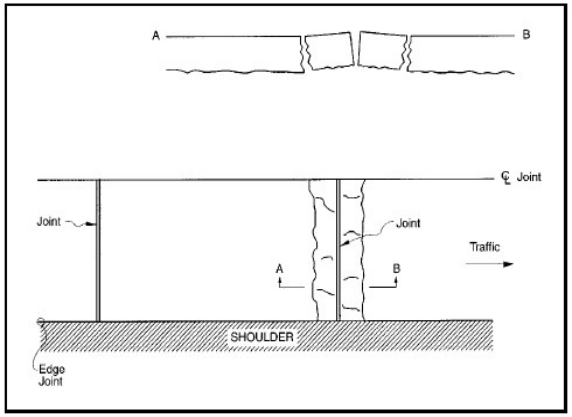
Severity Levels
<table>
<tr><th colspan="2"></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td rowspan="2">MEASUREMENT</td><td>RWY & High-Speed TWY</td><td>Less than 13mm</td><td>13mm to 25mm</td><td>Inoperable</td></tr>
<tr><td>Other areas</td><td>Less than 25mm</td><td>25mm to 51mm</td><td>Inoperable</td></tr>
<tr><td colspan="2">PATTERN</td><td>Buckling/ shattering has not rendered the pavement inoperable, and only a slight amount of roughness exists</td><td>Buckling/shattering has not rendered the pavement inoperable, but a significant amount of roughness exists</td><td>Buckling /shattering has rendered the pavement inoperable</td></tr>
</table></td><td> 

Figure 15: Blow Up</td></tr>
</table>

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
	Recommended action to be taken: - Low - Take note of the distress existence Medium/High - Arrange for repair works	

4.1.2 Corner Breaks

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Corner Breaks</td><td>
A portion of the slab separated by a crack, which intersects the adjacent transverse and longitudinal joints, describing approximately a 45-degree angle with the direction of traffic. The length of the sides is from 0.3 m to one-half the width of the slab on each side of the corner.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>PATTERN</td><td>Crack is not spalled for more than 10 percent of the length of the crack; there is no measurable faulting; and the corner piece is not broken into two or more pieces and has no loss of material and no patching</td><td>Crack is spalled at low severity for more than 10 percent of its total length; or faulting of crack or joint is < 13 mm; and the corner piece is not broken into two or more pieces</td><td>Crack is spalled at moderate to high severity for more than 10 percent of its total length; or faulting of the crack or joint is > 13 mm; or the corner piece is SYMBOL broken into two or more pieces or contains patch material</td></tr>
</table>
Recommended action to be taken: -

Low - Take note of the distress existence

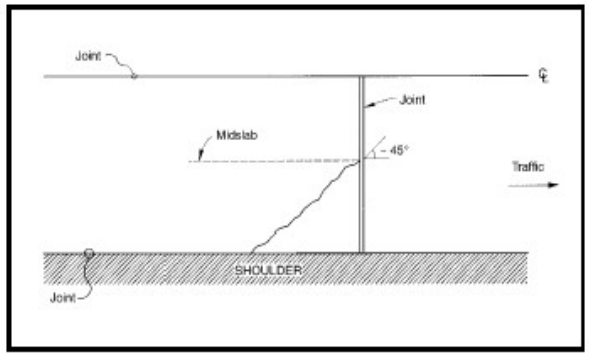
Medium - Close monitoring
</td><td>


Figure 16a: Depression

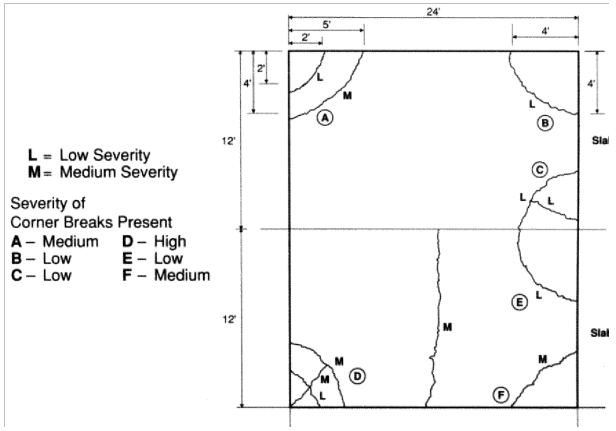


Figure 16b: Various Severity Levels of Corner Breaks
</td></tr>
</table>

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
	High - Arrange for repair works	 **Figure 16c: Corner Breaks at rigid pavement**

4.1.3 Longitudinal Cracking

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Longitudinal Cracking</td><td>Longitudinal Cracks that are predominantly parallel to the pavement centreline.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>Longitudinal</td><td>Crack widths < 3 mm, no spalling and no measurable faulting; or well-sealed and with a width that cannot be determined</td><td>Crack widths 3 mm and < 13 mm; or with spalling < 75 mm; or faulting up to 13 mm</td><td>Crack widths 13 mm; or with spalling 75 mm; or faulting 13 mm</td></tr>
</table>
Recommended action to be taken: -

Low - Take note of the distress existence

Medium - Close monitoring

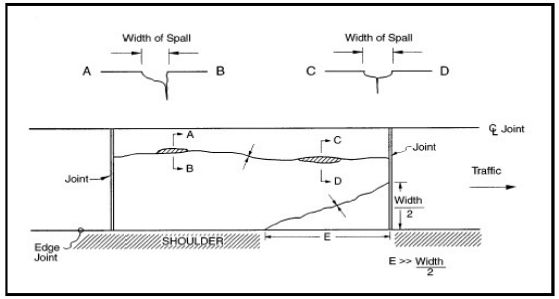
High - Arrange for repair works</td><td> 

Figure 17: Longitudinal Cracking</td></tr>
</table>

4.1.4 Transverse Cracking

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr>
<td>Transverse Cracking</td>
<td>Transverse Cracks that are predominantly perpendicular to the pavement centreline.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>Transverse</td><td>Crack widths < 3 mm, no spalling and no measurable faulting; or well-sealed and the width cannot be determined</td><td>Crack widths 3 mm and < 6 mm; or with spalling < 75 mm; or faulting up to 6 mm</td><td>Crack widths < 6 mm, or with spalling < 75 mm; or faulting up to 6 mm</td></tr>
</table>
Recommended action to be taken: -

Low - Take note of the distress existence

Medium - Close monitoring

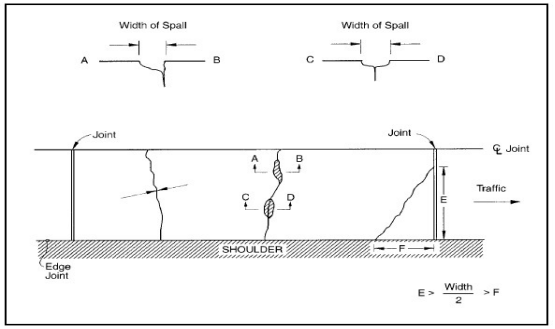
High - Arrange for repair works</td>
<td> 

Figure 18a: Transverse Cracking


Figure 18b: Transverse Cracking at rigid pavement</td>
</tr>
</table>

4.1.5 Durability Cracking **("D" CRACKING)**

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Durability Cracking
("D" CRACKING)</td><td>Closely spaced crescent-shaped hairline cracking pattern. Occurs adjacent to joints, cracks, or free edges; initiating in slab corners. Dark coloring of the cracking pattern and surrounding area

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>PATTERN</td><td>"D" cracks are tight, with no loose or missing pieces, and no patching is in the affected area</td><td>“D" cracks are well-defined, and some small pieces are loose or have been displaced.</td><td>"D" cracking has a well-developed pattern, with a significant amount of loose or missing material. Displaced pieces, up to 0.1 m2, may have been patched.</td></tr>
</table>
Recommended action to be taken: -

Low - Take note of the distress existence

Medium - Close monitoring

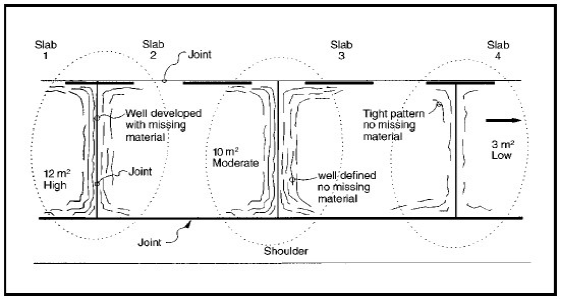
High - Arrange for repair works</td><td> 

Figure 19: Depression</td></tr>
</table>

4.1.6 Joint Seal Damage

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Joint Seal Damage</td><td>
Joint seal damage is any condition which enables incompressible materials or water to infiltrate the joint from the surface. Typical types of joint seal damage are extrusion, hardening, adhesive failure (bonding), cohesive failure (splitting), or complete loss of sealant, intrusion of foreign material in the joint, weed growth in the joint.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>PATTERN</td><td>Joint seal damage as described above exists over less than 10 percent of the joint</td><td>Joint seal damage as described above exists over 10-50 percent of the joint</td><td>Joint seal damage as described above exists over more than 50 percent of the joint</td></tr>
</table>
Recommended action to be taken: -

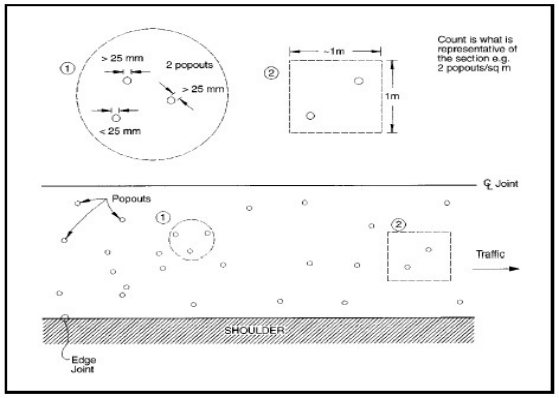
Low - Take note of the distress existence

Medium - Close monitoring

High - Arrange for repair works
</td><td>


Figure 20: Joint Seal Damage
</td></tr>
</table>

4.1.7 Pop Outs

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
Pop Outs	Small pieces of pavement broken loose from the surface, normally ranging in diameter from 25 mm to 100 mm, and depth from 13 mm to 50 mm. **Severity Levels** No degrees of severity are defined. Pop outs must be extensive before they are counted as distress. **How to measure the severity: -** Observe the existence of the pop outs. **Recommended action to be taken: -** Take note of the distress existence and arrange for repair works if required	 **Figure 21: Pop Outs**

4.1.8 Pumping

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
Pumping	Pumping is the ejection of material by water through joints or cracks caused by deflection of the slab under passing loads. Pumping can occur at cracks as well as joints **Severity Levels** No degrees of severity are defined. **How to measure the severity: -** Observe the existence of the pumping **Recommended action to be taken: -** Take note of the distress existence and arrange for repair works if required	 **Figure 22: Pumping**

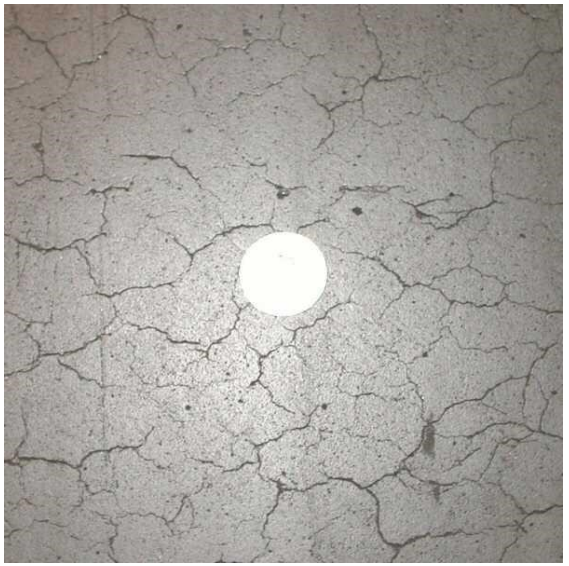
4.1.9 Scalling, Map Cracking

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr>
<td>Scalling,
Map Cracking</td>
<td>Map cracking and crazing refers to a network of shallow, fine or hairline cracks that extend only through the upper surface of the concrete.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>PATTERN</td><td>Crazing or map cracking exists over significant slab area. The surface is in good condition with no scalling</td><td>Slab is scaled over 5% or less of the surface with some FOD potential</td><td>Slab is severely scaled causing a high FOD potential. More than 5% of the surface is affected</td></tr>
</table>
Recommended action to be taken: -

Low - Take note of the distress existence

Medium - Close monitoring

High - Arrange for repair works</td>
<td> 
Figure 23: Scalling</td>
</tr>
</table>

4.1.10 Spalling

<table>
<tr><th>PAVEMENT DISTRESSES</th><th>DESCRIPTION</th><th>ILLUSTRATION</th></tr>
<tr><td>Spalling</td><td>
Cracking, breaking, chipping, or fraying of slab edges within 0.3 m from the face of the longitudinal /transverse joint.

Severity Levels
<table>
<tr><th></th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>WIDTH</td><td>Less than 75mm</td><td>75 to 150mm</td><td>More than 150mm</td></tr>
<tr><td>PATTERN</td><td>Measured to the face of the joint, with loss of material, or spalls with no loss of material and no patching</td><td>Measured to the face of the joint, with loss of material</td><td>Measured to the face of the joint, with loss of material or is broken into two or more pieces or contains patch material</td></tr>
</table>
Recommended action to be taken: -

Low - Take note of the distress existence

Medium - Close monitoring

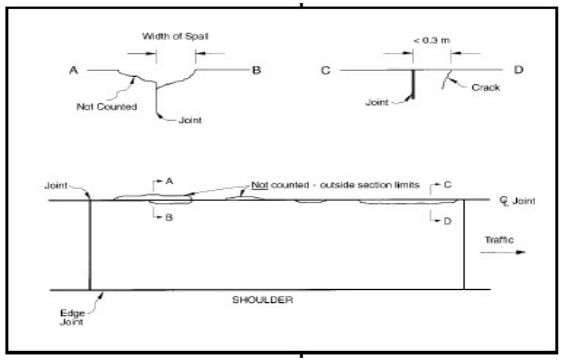
High - Arrange for repair works
</td><td>


Figure 24a: Spalling of Longitudinal Joints

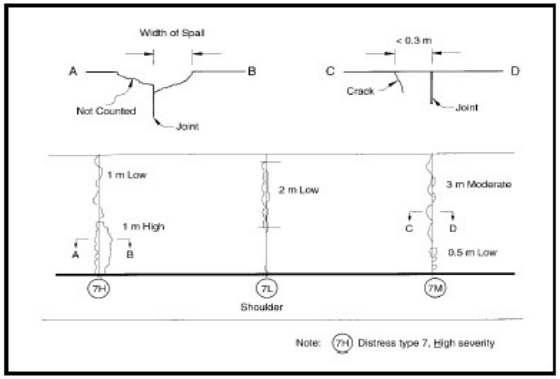


Figure 24b: Spalling of Transverse Joints
</td></tr>
</table>

PAVEMENT DISTRESSES	DESCRIPTION	ILLUSTRATION
		 **Figure 24c: Spalling at rigid pavement**

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