



AIRFIELD PAVEMENT MAINTENANCE WHEN TO APPLY

SWIFT 2022 - Chris Olidis, P.Eng.

PAVEMENT MAINTENANCE NEEDS

- Benefits of Preventative Maintenance
- Using PMS to identify needs
- Project level planning



WHY DO SOME PAVEMENTS LAST?



AND SOME DON'T



PAVEMENT MAINTENANCE!

- Nothing lasts forever
- Pavement maintenance is largely corrective / restorative
 - A maintenance activity performed after pavement defects occur; i.e., loss of pavement friction, rutting, spalling, cracking, etc.
 - Part of a planned/programmed toolbox of treatments to mitigate pavement distress(s).

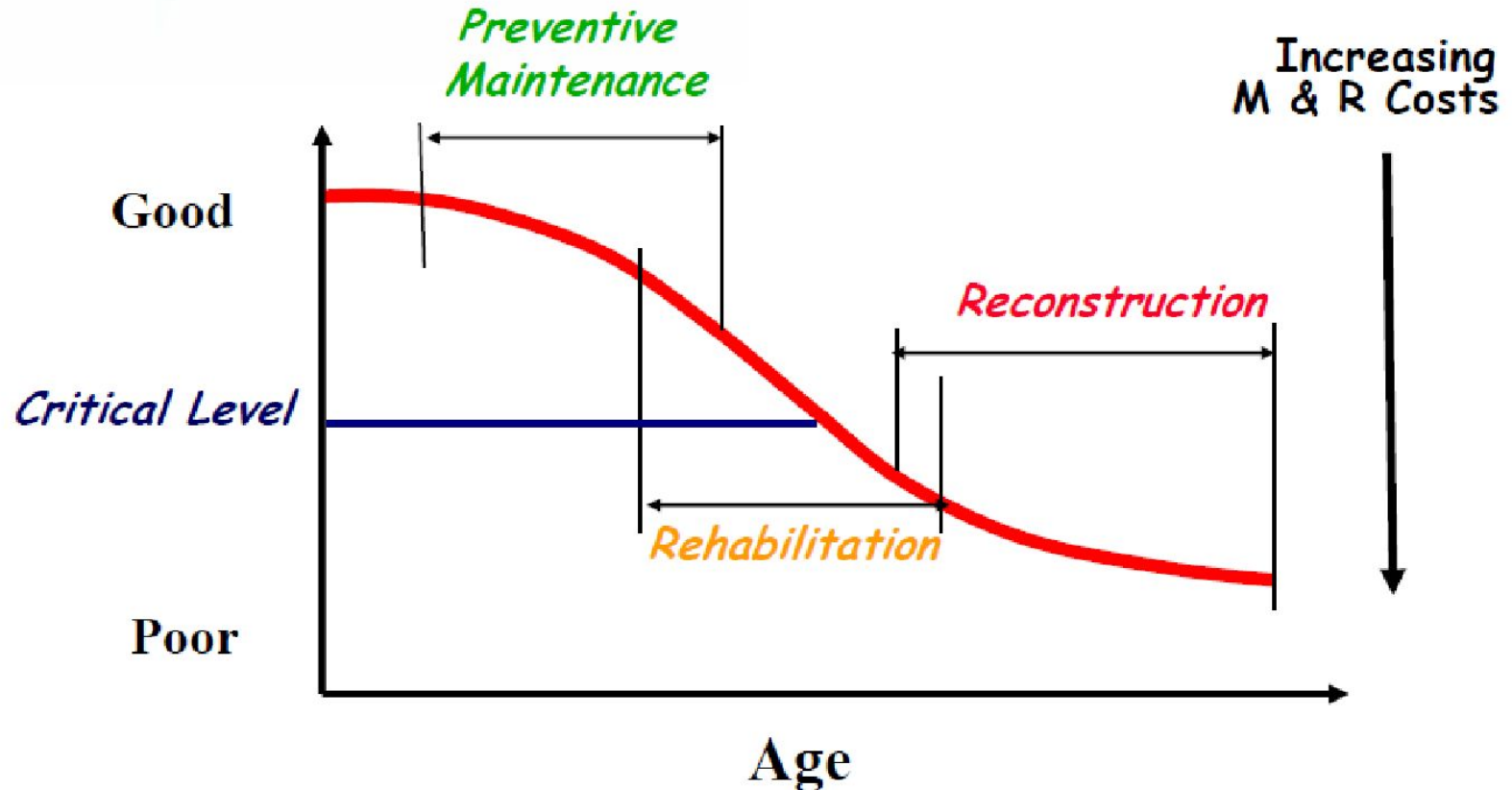
AIRFIELD MAINTENANCE

Timely maintenance and repair of pavements is essential in maintaining adequate load-carrying capacity, good ride quality necessary for the safe operation of aircraft, good friction characteristics under all weather conditions, and minimizing the potential for foreign object debris (FOD). FAA AC 150/5380-6C

PREVENTATIVE MAINTENANCE

Preventive Maintenance is a planned strategy of cost-effective treatments to an existing pavement that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system. AASHTO 1997

PAVEMENT CONDITION vs COST



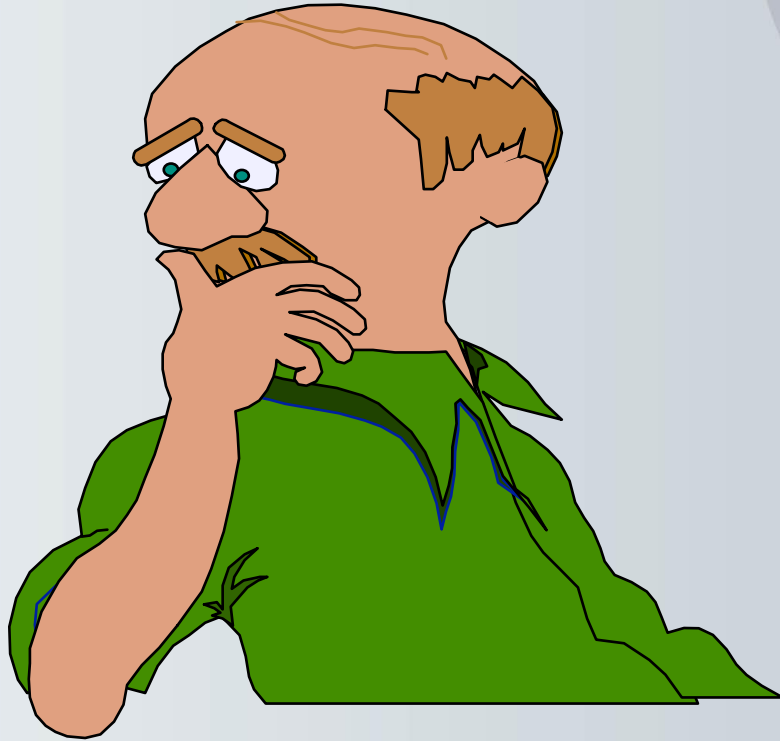
EXAMPLE: SEALING CRACKS



EMERGENCY MAINTENANCE

- Emergency Maintenance
 - A treatment performed to address emergency situations, such as filling in a large pothole or removing foreign object debris potential.
 - Typically an unplanned temporary treatment to quickly restore operational readiness/safety.

HOW CAN PMS HELP?



PAVEMENT MANAGEMENT OBJECTIVE

- An analytical tool to **optimize** the available funding or justify additional funding to improve the roadway network conditions.
- Allocate and prioritize **cost-effective** maintenance & rehabilitation alternatives based on:
 - Sound Engineering Judgment – Performance Indices
 - Benefit/Cost Analysis
 - Geographical Information Systems (GIS)
 - Local Construction Practices
 - Technical Specifications

WHAT IS PAVEMENT MANAGEMENT?

- Pavement management is the systematic process of managing, maintaining, upgrading and operating a pavement network

A system to regularly collect pavement condition data

A computer database and mapping program to sort and store the collected data

An analysis program to evaluate repair/maintenance strategies and suggest cost- effective options

PAVEMENT MANAGEMENT TOOLS

- A Pavement Management System (PMS) can be an effective tool



- Inventory and Condition
 - Branches / sections in the network
- Management
 - Family deterioration curves
 - Maintenance policies
- Reporting
 - Current and future conditions
 - Economic analysis

DISTRESS IDENTIFICATION

*Accurate assessment
and understanding of
distress conditions is
critical*

**Load Related
Longitudinal Cracks**

Shattered Slab

**High severity block
cracking**

High Severity Corner Spall

EVALUATE CONDITION

- Most common pavement condition survey method:
 - ASTM D5340 – Standard Test Method for Airport Pavement Condition Index Surveys
- Transport Canada:
 - ERD 121 – Guidelines Respecting Airport Structural Condition Surveys
 - AK-68-32 Airport Pavement Evaluation – Condition Surveys (archived)

ASTM D5340-20 DISTRESS TYPES

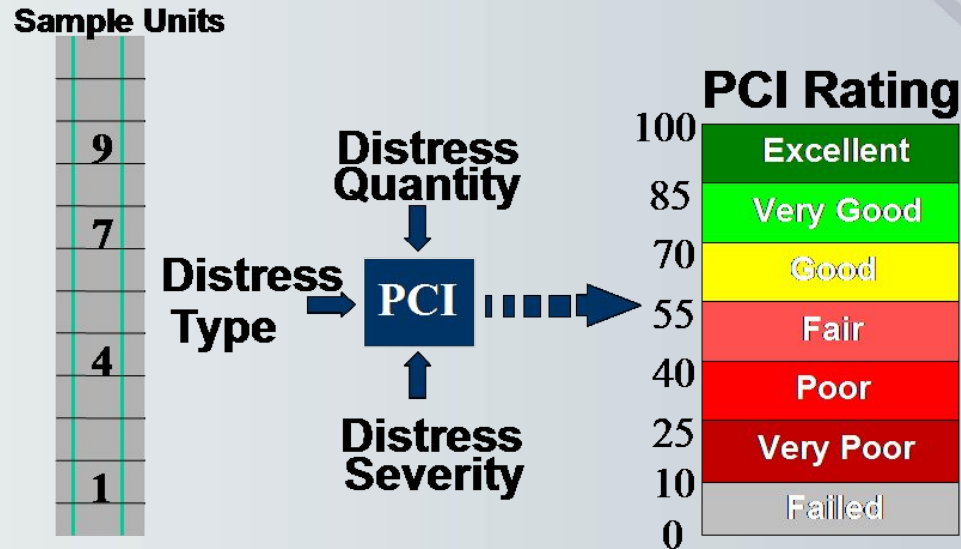


Description	Mechanism
Blow-up	Climate
Corner break	Load
Linear cracking	Load
Durability cracking	Climate
Joint seal damage	Climate
Small patch	Other
Large patch	Other
Popouts	Other
Pumping	Other
Scaling	Other
Faulting	Load
Shattered slab	Load
Shrinkage cracking	Other
Joint spalling	Other
Corner spalling	Other
ASR	Other

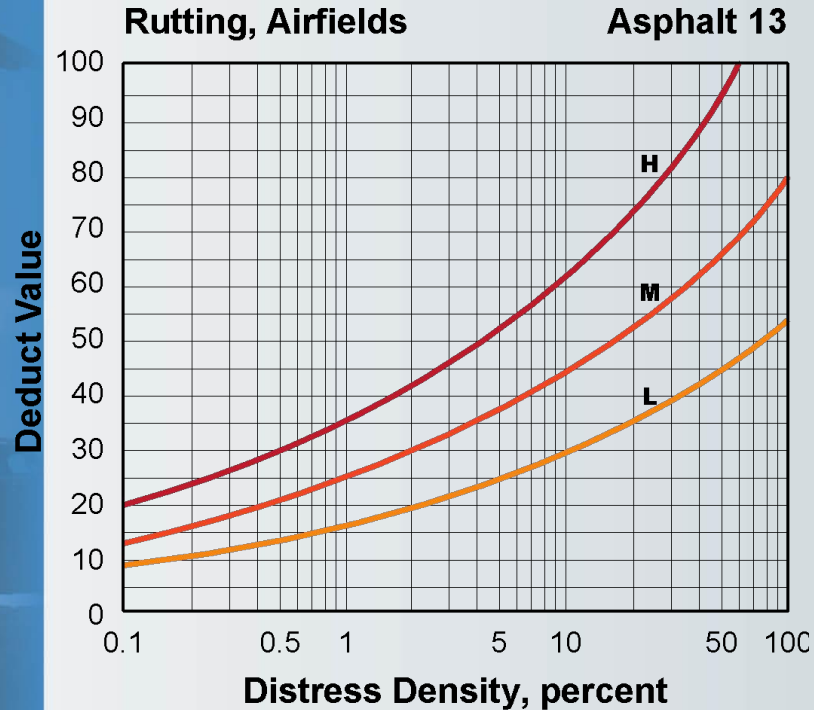
Description	Mechanism
Alligator cracking	Load
Bleeding	Other
Block cracking	Climate
Corrugation	Other
Depression	Other
Jet blast	Other
Joint reflection cracking	Other
Longitudinal and transverse cracking	Climate
Oil spillage	Other
Patching	Other
Polished aggregate	Other
Raveling	Other
Rutting	Load
Shoving	Other
Slippage cracking	Other
Swelling	Other
Weathering	Climate

PAVEMENT CONDITION INDEX

- Each distress has an associated deduct value
- PCI equals 100 less amount of total deducts



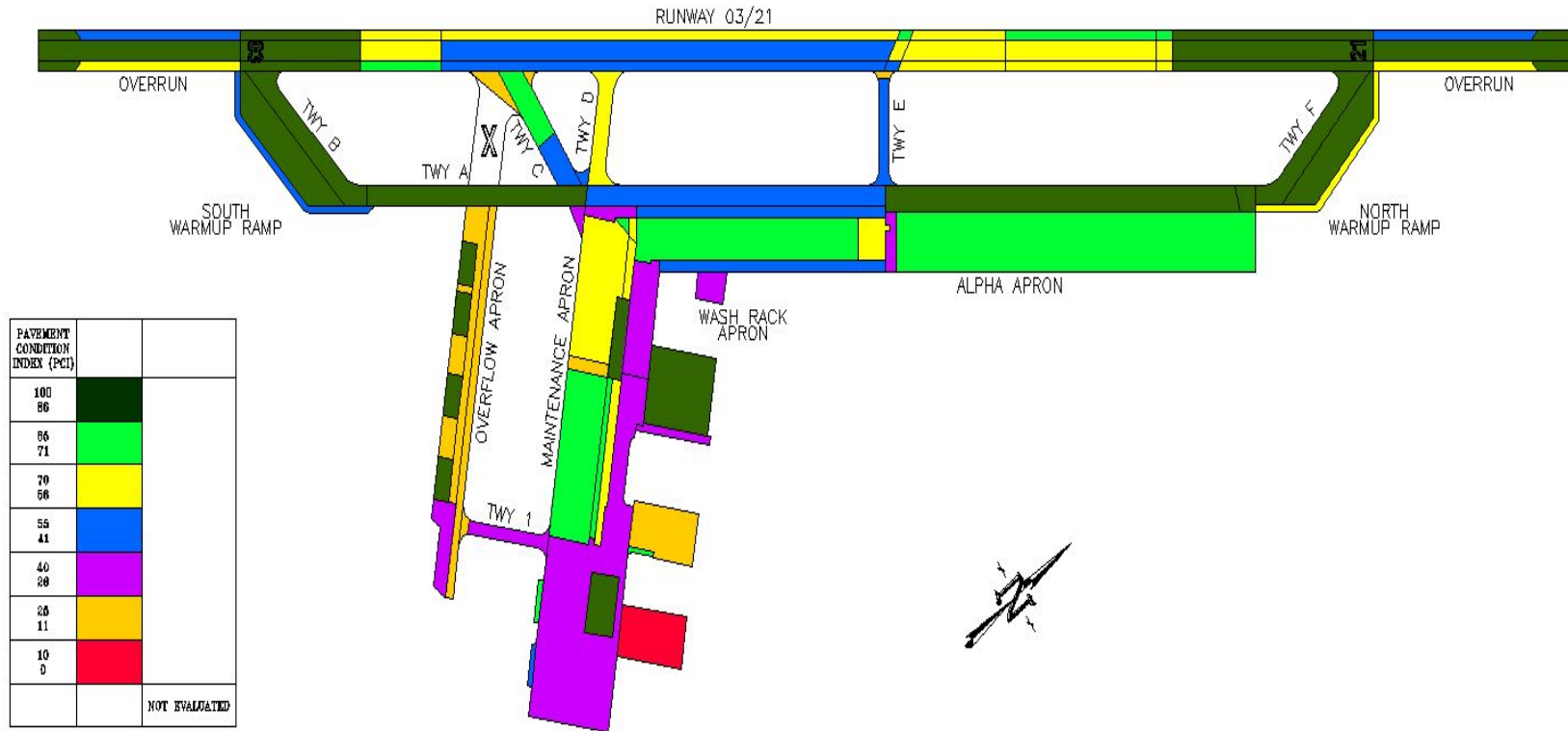
RUTTING DEDUCT CURVES



Severity	Quantity	Density	PCI
Low	600	12	70
Medium	110	2.2	70
High	30	0.6	70

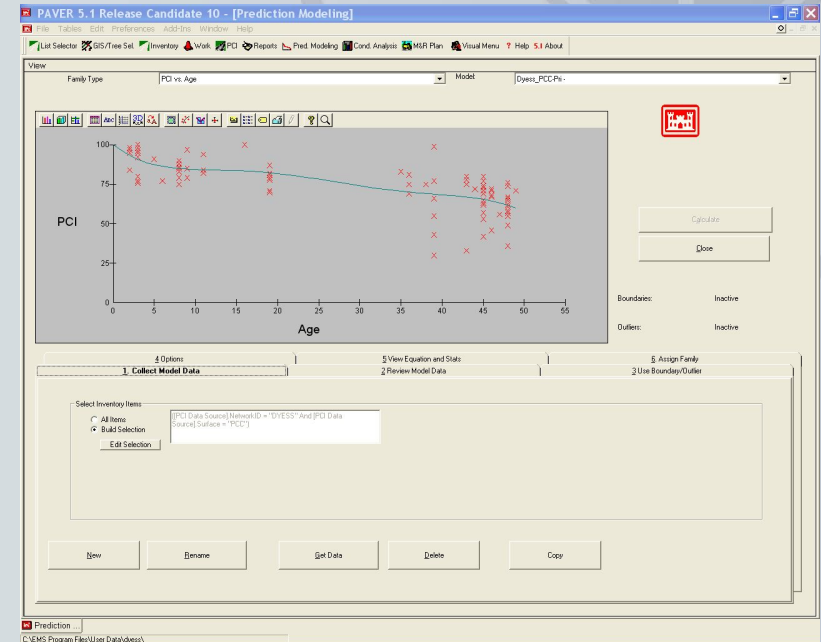
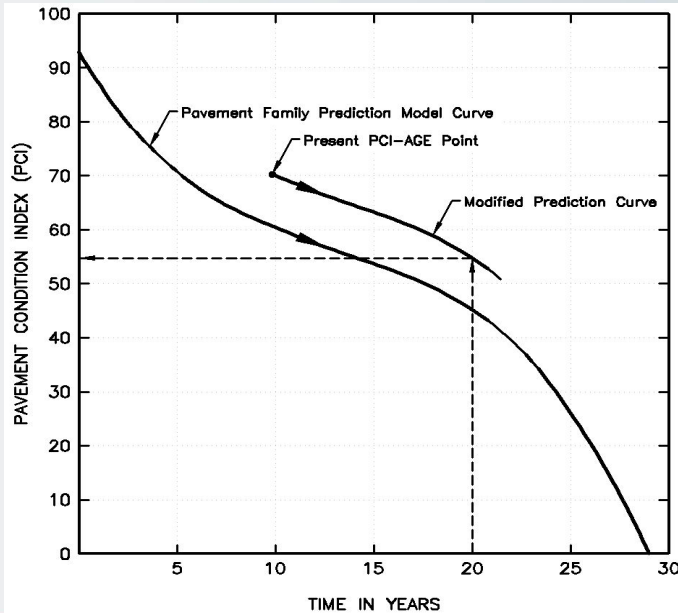


PAVEMENT CONDITION REPORTING



DETERIORATION MODELING

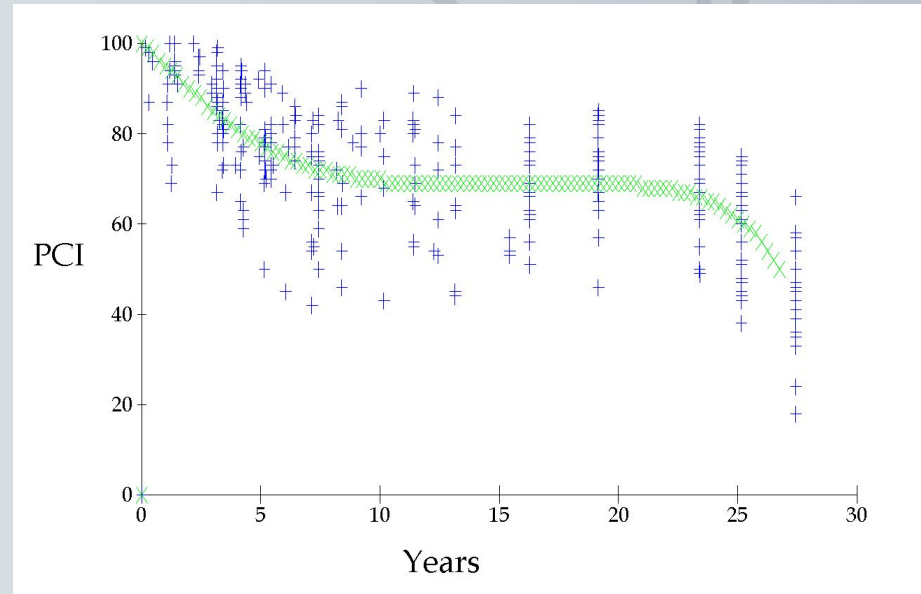
- Future condition is predicted by PMS software.



- Rate of deterioration defined by current condition and age of all sections in the family.

PCI FAMILY MODELING

- Does the model make sense?
 - Yes?
 - No?
 - Maybe?
- Agency experience??



MAINTENANCE POLICIES

Preventive M&R Tables

4) Consequence Of Maintenance Policy 5) Preventive Cost By Condition 6) Preventive M&R Families

1) Work Types 2) Cost By Work Type Tables 3) Distress Maintenance Policies

Name: 2019_Alexandria_Preventive_DMP

Distress	Severity	Description	Code	Work Type	Work Unit
1	High	ALLIGATOR CR	PA-AD	Patching - AC Deep	SqR
1	Medium	ALLIGATOR CR	PA-AD	Patching - AC Deep	SqR
3	High	BLOCK CR	CS-AC	Crack Sealing - AC	R
4	Medium	BUMPS/SAGS	PA-AS	Patching - AC Shallow	SqR
4	High	BUMPS/SAGS	PA-AD	Patching - AC Deep	SqR
5	Medium	CORRUGATION	PA-AS	Patching - AC Shallow	SqR
5	High	CORRUGATION	PA-AD	Patching - AC Deep	SqR
6	Medium	DEPRESSION	PA-AD	Patching - AC Deep	SqR
6	High	DEPRESSION	PA-AD	Patching - AC Deep	SqR
7	Medium	EDGE CR	CS-AC	Crack Sealing - AC	R
7	High	EDGE CR	PA-AS	Patching - AC Shallow	SqR
8	High	JT REF. CR	PA-AS	Patching - AC Shallow	SqR
8	Medium	JT REF. CR	CS-AC	Crack Sealing - AC	R
9	Medium	LANE SH DRG	SH-LE	Shoulder leveling	R
9	High	LANE SH DRG	SH-LE	Shoulder leveling	R
10	Medium	L & T CR	CS-AC	Crack Sealing - AC	R
10	High	L & T CR	PA-AS	Patching - AC Shallow	SqR
11	High	PATCH/UT CUT	PA-AD	Patching - AC Deep	SqR
13	Low	POTHOLE	PA-AD	Patching - AC Deep	SqR
13	High	POTHOLE	PA-AD	Patching - AC Deep	SqR
13	Medium	POTHOLE	PA-AD	Patching - AC Deep	SqR

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Stopgap M&R Tables

4) Consequence Of Maintenance Policy 5) Stop Gap Cost By Condition 6) Stopgap M&R Families

1) Work Types 2) Cost By Work Type Tables 3) Distress Maintenance Policies

Name: 2019_Alexandria_StopGap_DMP

Distress	Severity	Description	Code	Work Type	Work Unit
1	High	ALLIGATOR CR	NONE	No Localized M & R	SqR
11	High	PATCH/UT CUT	PA-AD	Patching - AC Deep	SqR
13	Medium	POTHOLE	PA-AD	Patching - AC Deep	SqR
13	High	POTHOLE	PA-AD	Patching - AC Deep	SqR
21	High	BLOW UP	PA-PF	Patching - PCC Full Depth	SqR
25	High	FAULTING	GR-PP	Grinding (Localized)	R

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M&R COSTING

Preventive M&R Tables

4) Consequence Of Maintenance Policy 5) Preventive Cost By Condition 6) Preventive M&R Families
 1) Work Types 2) Cost By Work Type Tables 3) Distress Maintenance Policies

Name: 2019_Alexandria_Localized_CxWT

Code	Name	Cost	Units
NONE	No Localized M & R	\$0.00	SqFt
CS-AC	Crack Sealing - AC	\$0.35	Ft
CS-PC	Crack Sealing - PCC	\$0.35	Ft
GR-PP	Grinding (Localized)	\$20.00	Ft
JS-LC	Joint Seal (Localized)	\$1.00	Ft
PA-AD	Patching - AC Deep	\$7.50	SqFt
PA-AS	Patching - AC Shallow	\$4.00	SqFt
PA-PF	Patching - PCC Full Depth	\$13.00	SqFt
PA-PP	Patching - PCC Partial Depth	\$13.00	SqFt
SH-LE	Shoulder leveling	\$1.00	Ft
SL-PC	Slab Replacement - PCC	\$13.00	SqFt

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GR-PP	Grinding (Localized)	\$20.00	Ft
JS-LC	Joint Seal (Localized)	\$1.00	Ft
PA-AD	Patching - AC Deep	\$7.50	SqFt
PA-AS	Patching - AC Shallow	\$4.00	SqFt
PA-PF	Patching - PCC Full Depth	\$13.00	SqFt
PA-PP	Patching - PCC Partial Depth	\$13.00	SqFt
SH-LE	Shoulder leveling	\$1.00	Ft
SL-PC	Slab Replacement - PCC	\$13.00	SqFt

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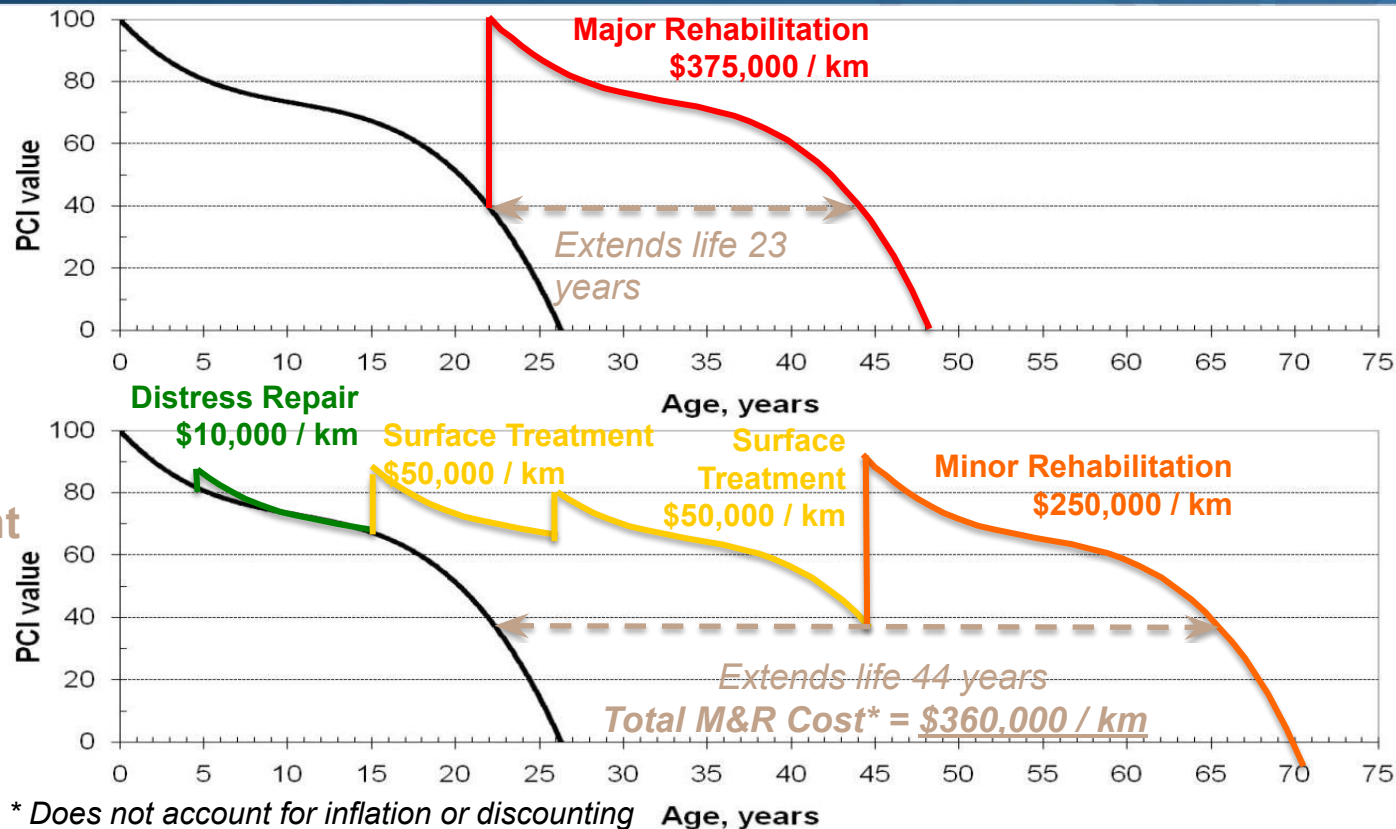
M&R RECOMMENDATIONS

Preventative maintenance PCI improvement

Work Item	Quantity	Unit	Cost	PCI Before	PCI After
Crack Sealing - AC	12,346	M	\$38,767	82	86
Crack Sealing - PCC	1,988	M	\$12,507		
Grinding (Localized)	413	M	\$11,387		
Joint Seal (Localized)	8,976	M	\$148,426		
Patching - AC Deep	129	SqM	\$35,598		
Patching - AC Shallow	31	SqM	\$7,485		
Patching - PCC Full Depth	159	SqM	\$58,827		
Patching - PCC Partial Depth	199	SqM	\$230,588		
Slab Replacement - PCC	285	SqM	\$94,231		
Surface Treatment	588	SqM	\$3,167		
Total:			\$640,983		

PREVENTIVE MAINTENANCE PAYS OFF

“Worst-First”



Prevent
Maint.

OTHER PAVEMENT METRICS

- Pavement Friction
 - Coefficient of Friction
- Pavement Roughness
 - Boeing Bump Index

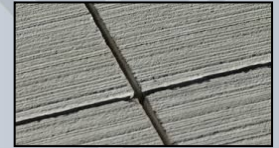


WHAT DO I DO NOW?



COMPLEX WORLD OF PAVEMENT

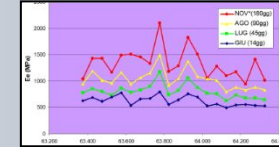
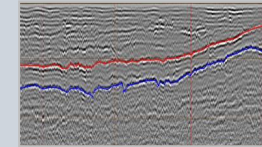
Materials



Processes



Construction



Loading



Environment



EVALUATE CAUSE(S)

- A detailed design Investigation is a must
- Determine the cause of the distress and the rehabilitation needs
- Right Treatment / Right Pavement / Right Time



PAVEMENT STRENGTH

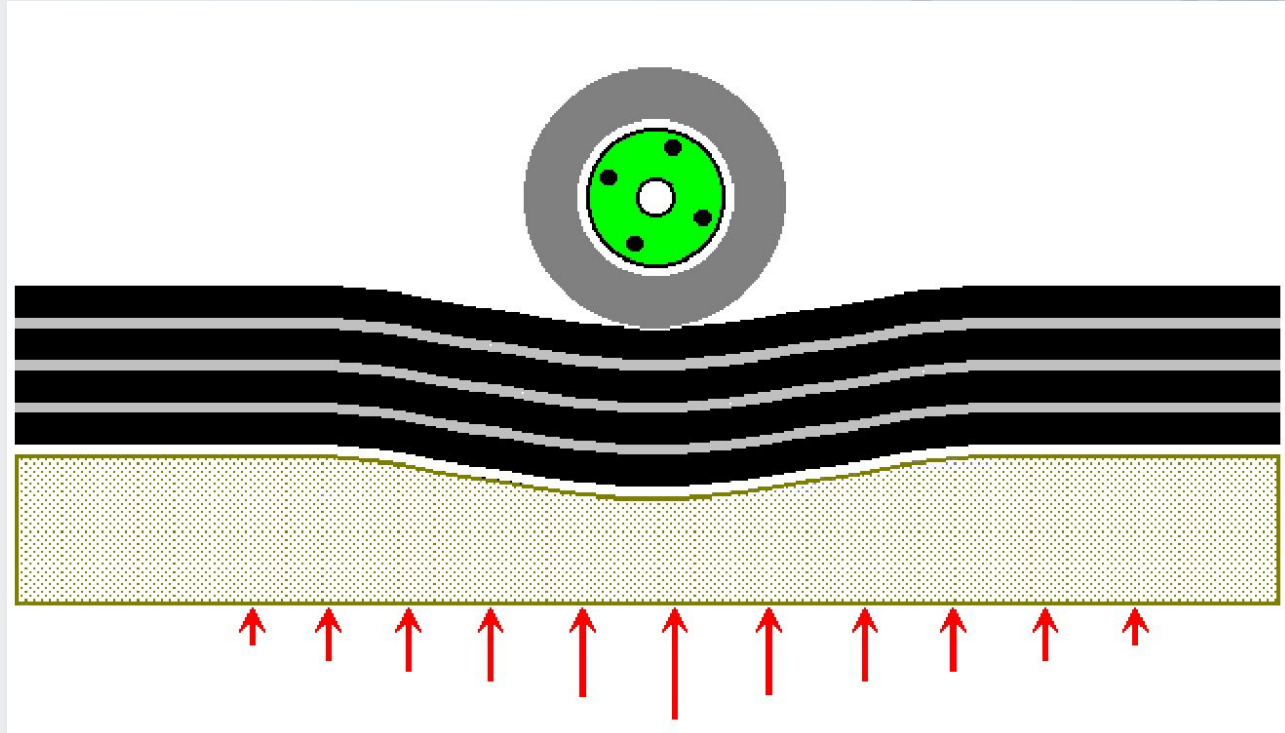
- Can the paved surface support aircraft operations and the critical aircraft?



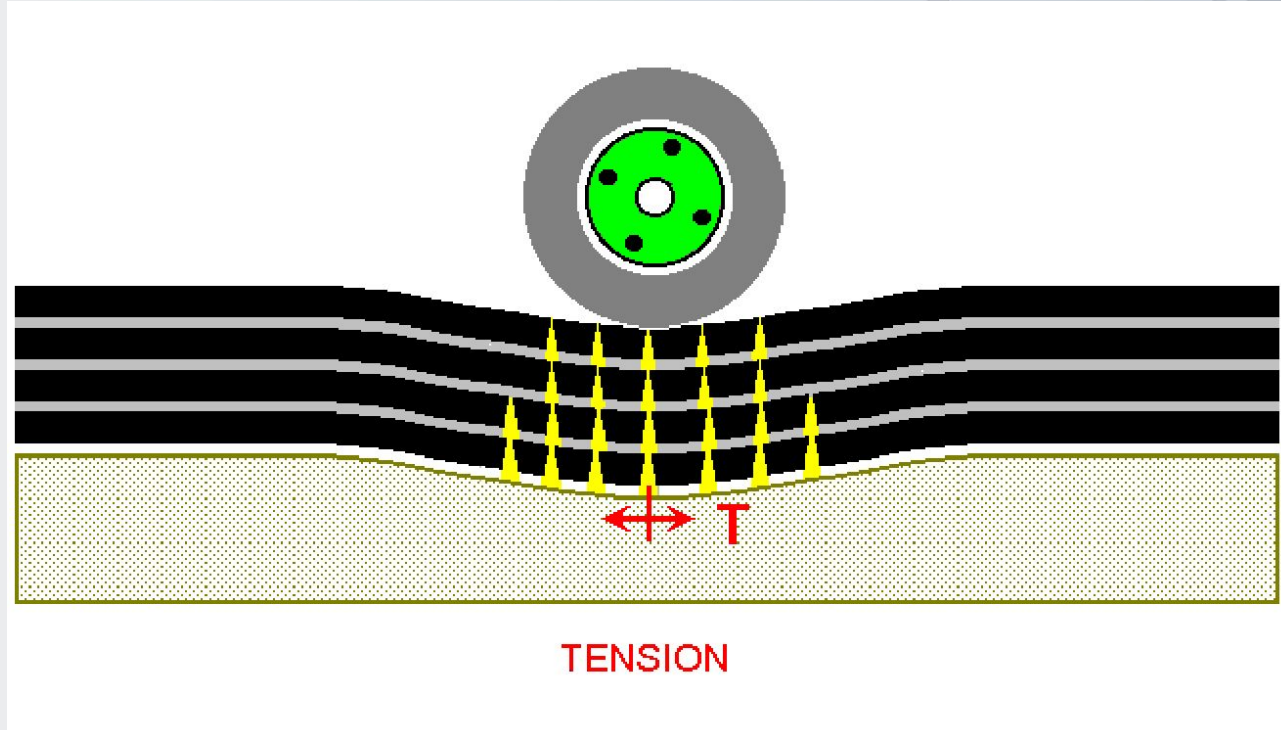
THE PROBLEM WAS NOT ADDRESSED



PAVEMENT FLEXES UNDER LOAD



REPEATED LOADS (FLEX PAVEMENT)



FATIGUE CRACKING

Low Severity



High Severity



- Insufficient bearing strength
- Asphalt Fatigue - excessive load repetitions

RUTTING



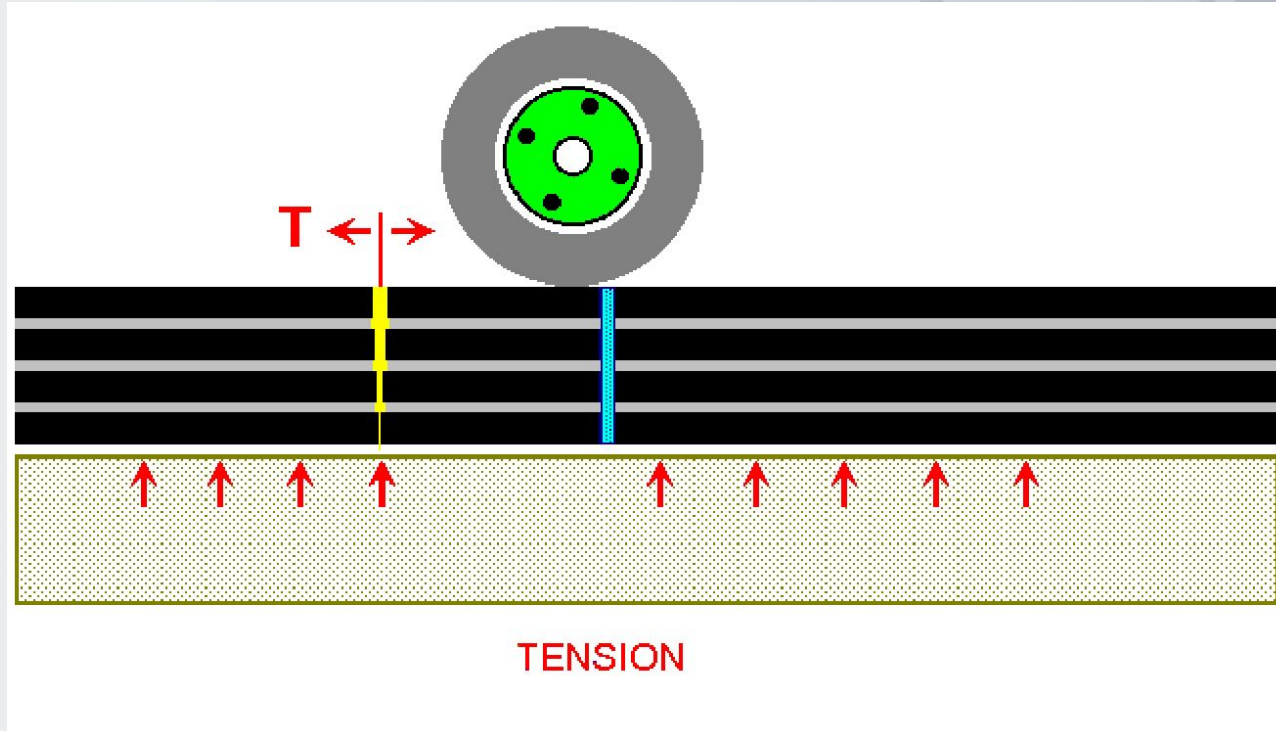
Compression Failure



Permanent Deformation

- Compression failure – overloading subgrade
- Permanent deformation - poor AC mix volumetrics

CORNER BREAK



GRADIENT RELATED STRESSES

- Temperature/moisture differential between the top and bottom of the slab

Night / Dry



cooler

drier



warmer

wetter

Day / Rainy



warmer

wetter



cooler

drier

CORNER BREAK



APMS SUMMARY

- An APMS is a decision making tool, not a solution
- Consider meaningful sections with like attributes
- Use trained inspection personnel
- Re-evaluate the deterioration models after each inspection
- Update construction history after each work program
- Select the right treatment, for the right pavement, at the right time

REFERENCE DOCUMENTS

ACRP SYNTHESIS 22

AIRPORT
COOPERATIVE
RESEARCH
PROGRAM

Sponsored by
the Federal
Aviation Administration



Common Airport Pavement
Maintenance Practices

A Synthesis of Airport Practice

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Report Number
AARME/C-02-04

Pavement Preservation
Catalogue for
Canadian Airfields

Final Report

Original Report Prepared by

D.K. Hein, J.J. Hajek, C. Olidis, and M. Popik
ERES Consultants
Toronto, Ontario
March 30, 2001

Report Edited and Reformatted by

The Technical Evaluation Engineering Division
Aerodrome Safety Branch
Transport Canada
Ottawa, Ontario
November, 2002

- Maintenance and Repair of Airport HMAC Pavement.
ERD 125-01
- Maintenance and Repair of Airport PCC Pavement.
ERD 125-02
- Joint/Crack Sealing of HMAC and PCC Pavement.
ERD 125-03
- Runway Rubber Removal.
ERD 125-04



Questions ?