Airport Pavement Management: FAA Perspective

ICAO - ACI/LAC Seminar on
Pavement Management Systems

Lima, Peru, 19 - 22 November, 2003

FAA Airport Technology R&D Program

- Based at the William J. Hughes Technical Center, Atlantic City, New Jersey, USA
- Sponsor: FAA Office of Airport Safety and Standards, Washington, DC
- Provide support for development of FAA pavement standards (Advisory Circulars).
- http://www.airporttech.tc.faa.gov/

FAA Guidance on Pavement Maintenance & Management

- FAA provides guidance on airport pavement maintenance & management practices through the Advisory Circular (AC) series.
- AC's are intended to protect public investment in airports funded through the U.S. Government Airport Improvement Program (AIP).
- *"Any airport requesting Federal funds for a project to replace or reconstruct a pavement under the airport grant assistance program must have implemented a pavement maintenance program."*

FAA Guidance on Pavement Maintenance & Management

- FAA requires airports requesting AIP grants to have a PMS in place.
- In general, routine pavement maintenance projects do not qualify for AIP funds.
- A Federal law passed in 2000 (AIR-21) made "*routine work to preserve and extend the useful life of runways, taxiways, and aprons*" eligible for AIP grants at **non-primary** airports. FAA makes this determination.

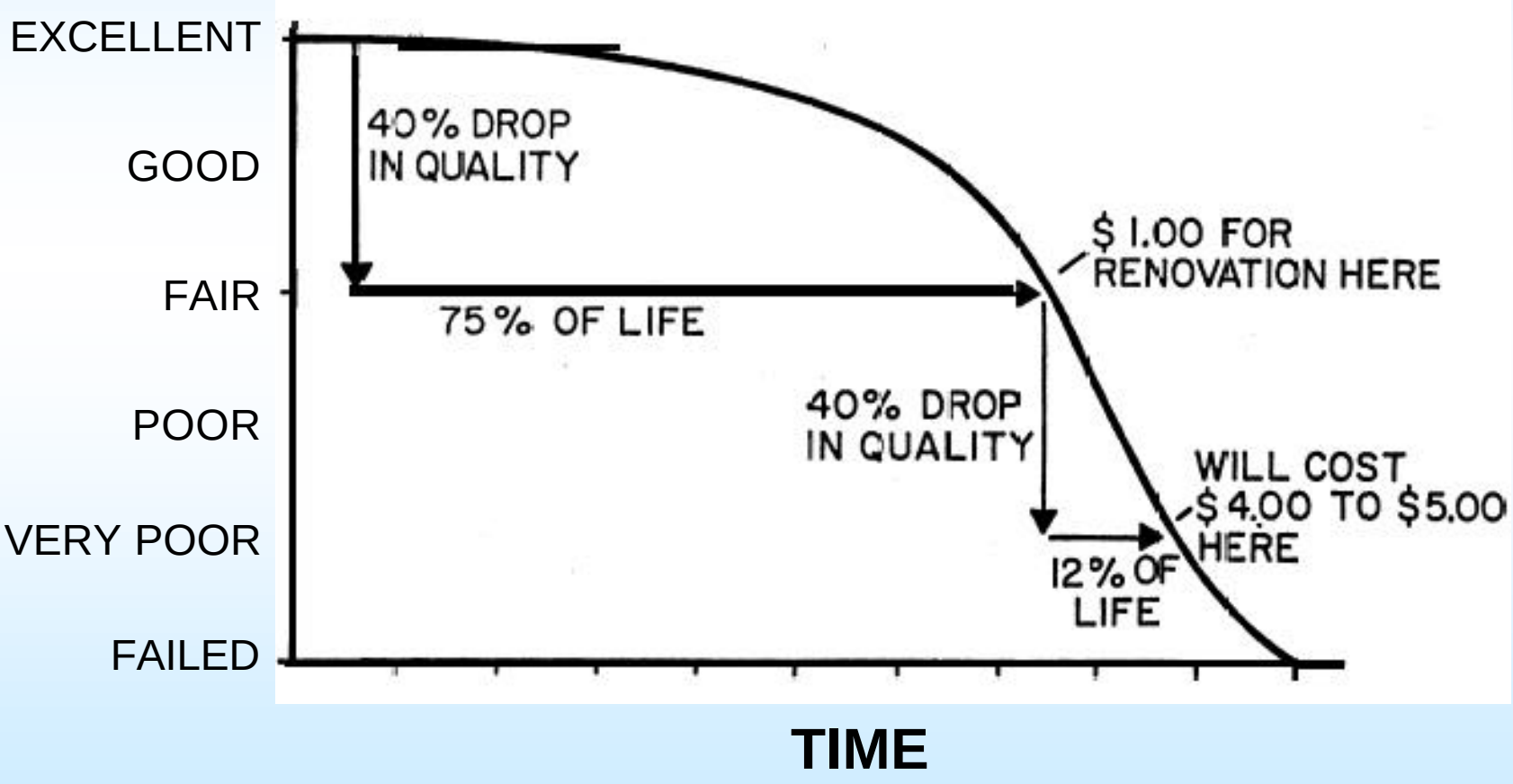
Relevant Advisory Circulars (Series 150)

- AC 150/5370-11, Use of Nondestructive Testing Devices in the Evaluation of Airport Pavements
- AC 150/5380-6A, Guidelines and Procedures for Maintenance of Airport Pavements
- AC 150/5380-7, Pavement Management System
- Also:
- AC 150/5320-6D, Airport Pavement Design and Evaluation (for structural evaluation)
- AC 150/5320-12C, Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

Pavement Management System AC 150/5380-7

- Outlines the main concepts of a PMS.
- Network vs. Project Level
- Identifies the major components of a PMS:
  - Means of collecting & storing information (database).
  - System of evaluating pavement condition.
  - Alternative strategies.
  - Performance & cost of alternatives.
  - Optimization.

Pavement Life Cycle



MicroPAVER Pavement Management System

- FAA endorses the MicroPAVER system.
  - PMS on Network and Project levels.
  - Based on the Pavement Condition Index (PCI).
  - Developed by US Army Construction Engineering Research Laboratory (CERL) under contract to FAA.
- FAA continues to support improvements to the MicroPAVER program.

Recent Developments

- Update to AC 150/5370-11, Use of Nondestructive Testing in the Evaluation of Airport Pavements.
- Update to Pavement Maintenance Manual (AC 150/5380-6)
- Guidance on rating methods for general aviation pavements (PASER system).
- Development of back-calculation software.

Update Advisory Circular on Nondestructive Testing (NDT)

- Existing AC was last updated in 1976.
- Represents technology of 30 years ago, i.e., WES vibratory loading device.
- FAA is updating this document to reflect the state of the art, including FWD devices.
- The draft document is available online: http://www2.faa.gov/arp/publications/acs/draftacs.cfm

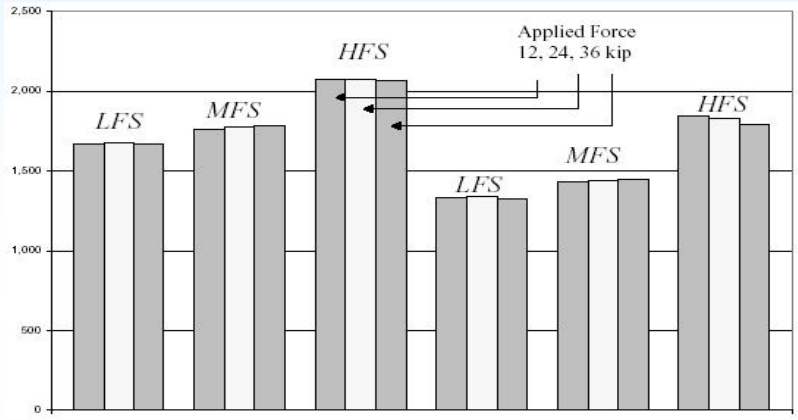
NDT Testing Guidelines

- FAA does not endorse a particular type of FWD equipment, but provides standards applicable to commonly used devices.
- Draft AC summarizes:
  - The experience of longtime FWD users.
  - The results of FAA studies conducted at Denver International Airport and the National Airport Pavement Test Facility (NAPTF).

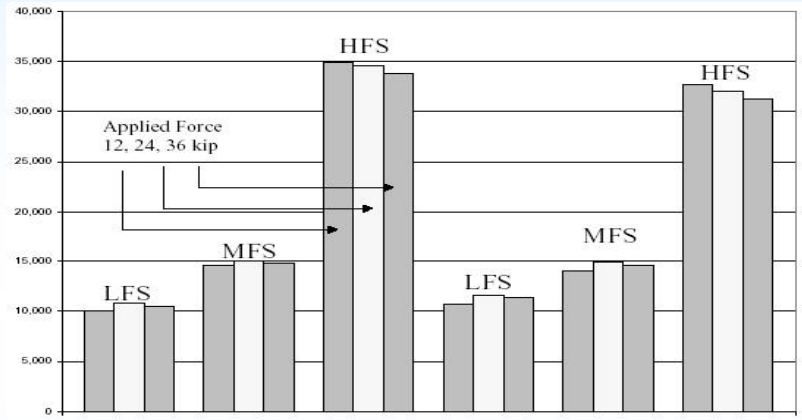
Commonly Used HWD Devices

HWD Testing at the NAPTF

HWD Linearity Study



BY ISM



BY SUBGRADE MODULUS

- ISM = Load / Max. Deflection of Load Plate
- Amplitude of impulse load not critical, provided the deflection response is within sensor limits.

NDT Data Analysis

- Recommended to use data analysis software with the same theoretical basis that will be used for design or evaluation study.
- BAKFAA program (FAA back-calculation analysis) based on LEAF (layered elastic).
- Suitable for pavement evaluation and design using LEDFAA. (For CBR method, need to convert modulus values to CBR.)

FAA Software Tools

for Pavement Analysis, Evaluation and Design

TOOL FUNCTION	NDT DATA ANALYSIS	EVALUATION*		DESIGN		
	BAKFAA	FEAFAA	COMFAA	LEDFAA	F806FAA	R805FAA
Back-calculate HMA moduli	•					
Back-calculate PCC moduli	•					
Back-calculate APC[2] moduli	•					
Compute load transfer		•				
Conduct void analysis		•				
Compute allowable loads		•	•	•	•	•
Compute remaining life		•	•	•		
Compute PCN			•			
Perform HMA overlay design				•	•	
Perform PCC overlay design				•		•
Design new HMA cross-section				•	•	
Design PCC Cross-section				•		•

*Not currently approved FAA design programs

BAKFAA Program

- Developed for internal use
- Not supported as a FAA standard
- For back-calculation of FWD data
- As a development platform for LEAF
- Program and source code available
- www.airporttech.tc.faa.gov/naptf/download/

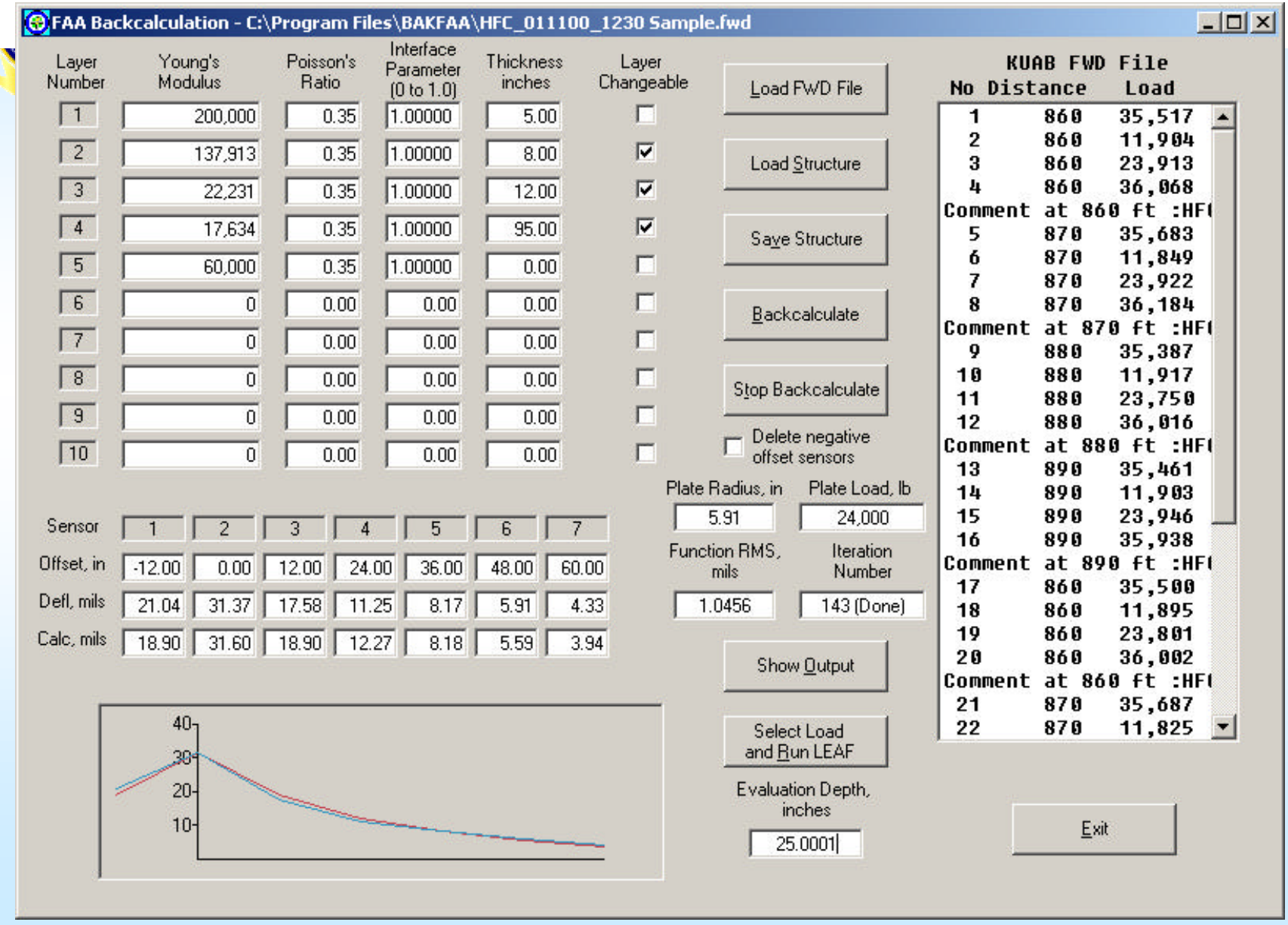
BAKFAA Features

- Iterative elastic layer back-calculation.
- Uses LEAF (FAA layered elastic program).
- Convergence method is RMS.
- For back-calculation, requires “seed” values.
- Can also be used for “forward” computations using LEAF (for given structure and load, compute responses).

Comparison of Linear Elastic Back-Calculation Programs

Program name	Developed by	Calculation subroutine	Rigid layer analysis	Layer interface analysis	Maximum number of layers	Convergence routine
BAKFAA	FAA	LEAF	Yes	Variable	10	rms
BISDEF	U.S. Army Corps of Engineers - WES	BISAR Proprietary	Yes	Variable	Cannot exceed no. of deflections. Works best for three unknowns	Sum of sq. of absolute error
CHEVDEF	U.S. Army Corps of Engineers - WES	CHEVRON	Yes	Fixed (rough)	Cannot exceed no. of deflections. Works best for three unknowns.	Sum of sq. of absolute error
ELSDEF	Texas A&M Univ.; U.S. Army Corps of Engineers - WES	ELSYM5	Yes	Fixed (rough)	Cannot exceed no. of deflections. Works best for three unknowns	Sum of sq. of absolute error
MODULUS	Texas Trans Institute	WESLEA	Yes Variable	Fixed	Up to four unknowns, plus stiff layer	Sum of relative sq. error
WESDEF	U.S. Army Corps of Engineers - WES	WESLEA	Yes	Variable	Up to five layers	Sum of sq. of absolute error
MICHBAK	Michigan State	CHEVRON	Yes	Fixed	Up to four unknowns, plus stiff layer	Sum of relative sq. error

BAKFAA Program



Typical Seed Values Recommended by FAA for Back-calculation

Material	Low value, psi (MPa)	Typical value, psi/MPa	High value, psi/MPa
Asphalt concrete	70,000 (483)	500,000 (3447)	2,000,000 (13790)
Portland cement concrete	1,000,000 (6895)	5,000,000 (34474)	9,000,000 (62053)
Lean-concrete base	1,000,000 (6895)	2,000,000 (13790)	3,000,000 (20684)
Asphalt-treated base	100,000 (689)	500,000 (3447)	1,500,000 (10342)
Cement-treated base	200,000 (1379)	750,000 (5171)	2,000,000 (13790)
Granular base	10,000 (69)	30,000 (207)	50,000 (345)
Granular subbase or soil	5,000 (34)	15,000 (103)	30,000 (207)
Stabilized soil	10,000 (69)	50,000 (345)	200,000 (1379)
Cohesive soil	3,000 (21)	7,000 (48)	25,000 (172)

Update Pavement Maintenance Manual (AC 150/5380-6A)

- New AC became effective July 2003
- Principal changes to this AC:
  - Procedures and methodology to determine the Pavement Condition Index (PCI) were removed from the AC and referenced to the current industry standard (ASTM D 5340).
  - Provides guidance on minimum inspection and maintenance programs.
  - Updates equipment and maintenance procedures to current industry practice.

Minimum Elements of Pavement Maintenance Management Program

- Pavement Inventory
- Inspection Schedule
  - Detailed Inspection
  - Drive-By Inspection
  - Record Keeping (minimum 5 years)
- Information Retrieval
- Program Funding

Maintenance programs required by the FAA must contain at least these five elements.

Classification of Distresses

	Rigid:	Flexible:
a. Cracking	L/T cracks, corner breaks, D-cracking, joint seal damage, shattered slab	L/T cracks, alligator cracks, block cracking, slippage cracking, reflection cracking
b. Disintegration	Scaling, map cracking/ crazing, spalls, blowups	Raveling
c. Distortion	Pumping, faulting	Rutting, corrugation, shoving, depression, swelling
d. Loss of Skid Resistance	Polished aggregate, contamination	Polished aggregate, fuel spills, contamination

PASER (Pavement System Evaluation and Rating)

- Visual condition rating system (1 - 5 scale).
  - Intended for general aviation (GA) facilities.
  - Means of reporting condition within FAA.
  - Part of FAA Airport Safety Data (5010) Program.
- Suitable for users with minimal technical training.
- Will be issued as AC 150/5320-17.

National Airport Pavement Test Facility (NAPTF)

http://www.airporttech.tc.faa.gov/naptf/

LFC-1 Centerline Trafficking