Using PMS Data to Calibrate MEPDG Pavement Distress Prediction Models: A Case Study

MISSISSIPPI DEPARTMENT OF TRANSPORTATION

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May 7, 2007

MDOT's Two – Phase Implementation Approach

- Phase I - SS No. 163
- Applied Research Associates (ARA)
- Become familiar with Mississippi's materials, pavements, rehabs etc.
- Educate MDOT staff on info requirements for local calibration
- Develop a detailed plan for Phase II, local calibration

Data Sources

- Pavement management sections
- Mississippi's LTPP sites
- Warranty job data
- Other research project data

Decision to use PMS Data for Initial Calibration

- Budget considerations
- Volume and type of PMS data
- Depth and level of detail
- Longevity of PMS Data

MDOT's PMS Data Analysis Sections

- Homogeneous construction history and geometrics
- Identified by county/route/logmile/direction
- Use only typical section from plans
- Projects entered by Districts
- Approximately 5,400 sections in data

MDOT's PMS Data Condition/Distress

- Data collected every two years on entire network
- Rightmost through lane of undivided highways, north- and eastbound only
- Rightmost through lane of both directions for divided highways
- Laser data collected on 100% of through lanes
- Calibration done daily, QA sites collected

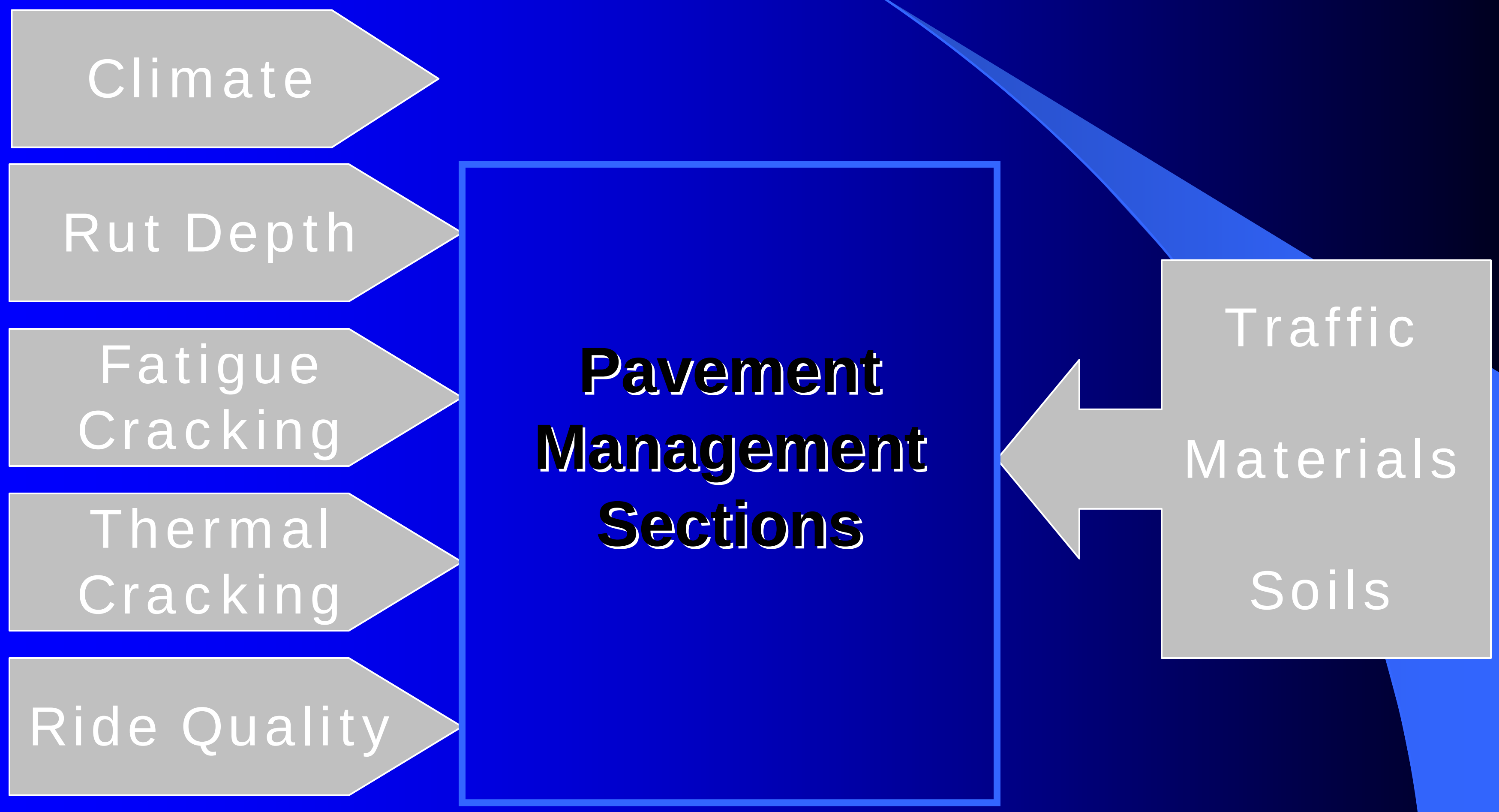
MDOT's PMS Data Condition/Distress continued

- Manual video distress analysis done on two 500-ft samples per mile
- QA done on randomly picked sections and based on queries for data problems
- Distresses quantified according to SHRP Manual
- Overall Pavement Condition Rating (PCR) calculated using deduct curves

MDOT's PMS Data Information Retrieval

- Data kept in TMIS (Transportation Management Information System)
- Report average fault, rut, IRI for entire section
- Report percentages of rut, IRI that fall into certain ranges
- Report distress quantities and/or densities
- Limited mapping, query & reporting

PMS Meets MEPDG



What Our PMS Data Has

- Layer types for all courses
- Layer thicknesses
- Project numbers
- Mix design numbers of surface course
- GIS-enabled/GPS coordinates
- Some material properties
- Several condition surveys' worth of data

What Our PMS Data Doesn't Have

- Distress data between samples
- Station numbers (yes and no), equations
- Material properties other than %AC, max aggregate size, gyratory/Marshall, PG, etc.
- Layer thicknesses other than typical plan section
- Skid/Deflection data on much of the system

Implementation

Identification of Typical Pavements Used in Mississippi

- Product of SS # 163 - development of Factorial Experiment Design for Calibration and Validation of Distress Prediction Models
- Table that captures various combinations of pavement structural sections and materials used in Mississippi; i.e. for a given pavement
- Starting with original construction AC

Factorial Experiment Design

Subgrade Type	Binder Type	Mix Type	Pavement Type											
			Conventional [1]			Semi Rigid [2]			Deep Strength [3]			AC overly over		
			AC Thickness											
			L	M	H	L	M	H	L	M	H	AC	JCP	CRCP
Non Stabilized	Modified	D												
		S												
	PG	D												
		S												
	Modified	D												
		S												
	PG	D												
		S												
Lime Stabilized	Modified	D												
		D												
	PG	S												
		D												
	Modified	S												
		D												
	PG	S												
		D												

Factorial Experiment Design

- 44 potential different combinations just for HMA
- Terms and definitions are <u>not</u> the same between MDOT PMS and MEPDG
- Some pavements could fit more than one category

Data Needs from PMS

- Polymer-modified vs. nonmodified binder
- Mix type (dense-graded, Superpave)
- Stabilized or unstabilized subgrade
- Classification by base layers
- Pavement thickness

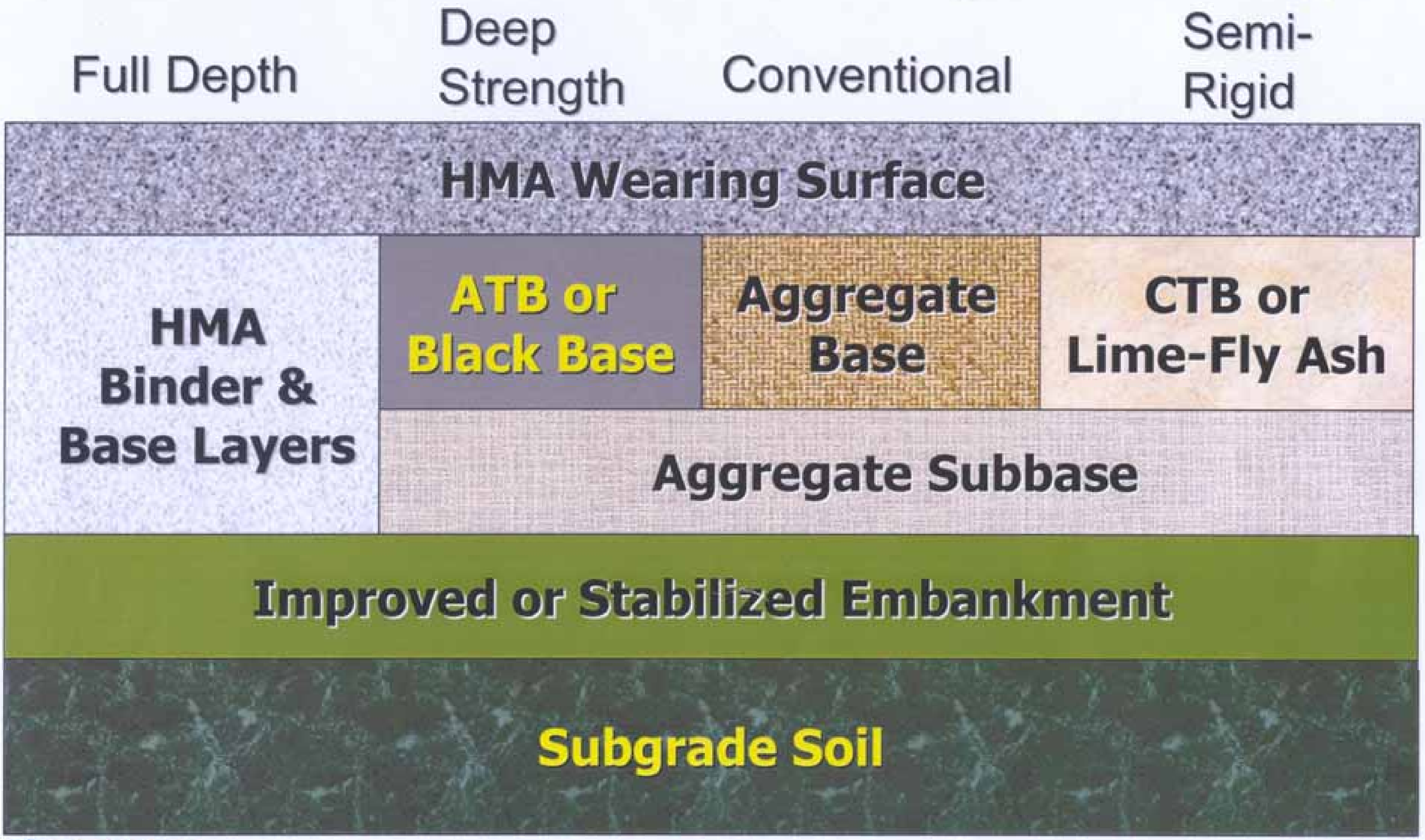
Summary – Factorial Options

Factors	Options	Description
Climate	1	**One climatic zone**
AC thickness	3	**Low, medium, high**
Base / subbase	2	**Stabilized, granular**
Subgrade soil	2	**Stabilized, nonstabilized**
Pavement type	5	**Conventional, deep strength, semi rigid, AC overlay of AC and PCC**
Binder type	2	**Conventional, modified**
Mix type	2	**Dense, Superpave**

Asphalt Pavement Types for MEPDG

- Conventional
  - AC over granular base/subbase
- Semi-rigid
  - AC over bound base/subbase with cementitious materials
- Deep strength
  - AC over bound base/subbase with asphalt
- Full Depth

Flexible Pavement Design Strategies



Distress Types for HMA Pavements

- Fatigue Cracking
- Longitudinal
- Smoothness/ride quality
- Rutting
- Thermal Cracking

Flexible Pavement Distresses

Issues with PMS Construction History Data

- Some samples fit more than one MEPDG pavement type (semi-rigid and deep-strength)
- Difficult to search some PMS data fields
- Some attributes not in PMS data
- Only have typical sections
- Limited material properties
- Project vs. network level

Issues with Distress Data

- Different weather conditions & operators
- Rater subjectivity
- Different classifications of distresses
- Can affect PCR calculations and trends
- Location referencing (logmile vs. stations)
- Only used 1997 and later

Distress Data Issues—cont'd

- No way to compare video year-to-year
- No way to easily query data for some desired attributes

Design Guide Challenges

- Software—v 1.0 to AASHTOware
- Analysis vs. design tool
- Iterative process
- Models not all finished yet

People Factors

- Personnel changes on both sides
- Business processes within MDOT
- Greatest Generation/Early Baby Boomer retirements
- Shift from field to computer
- Efforts to get data corrected

Decisions Made by MDOT & ARA

- Use only distress data since 1997
- Only sections ½-mile long or longer
- Only original construction asphalt at first
- Only sections constructed since 1985
- Find 500-ft samples that were in the same place year to year

PMS Data Process

- Query for desired pavement type, mix, thickness etc. to fit factorial experiment design
- Query samples to check location from year to year
- Check to see if the analysis section has been modified and when
- Check to see if as-built plans exist

PMS Data Process—cont'd

- Run through distress data extraction program
- ARA analyzes to see if sample(s) can be used

How Does Our Data Stack Up?

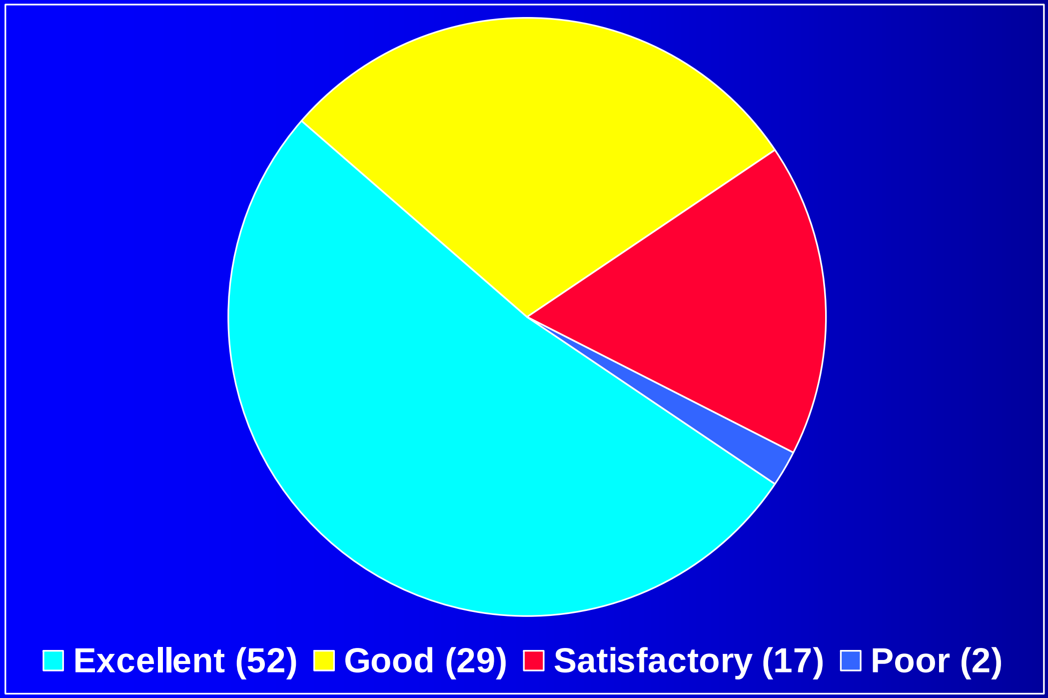
- New construction analysis sections
  - 66 analysis sections (379 500-ft sample units with data)
- Analysis conducted
  - Percent of good data (at sample unit level)
  - Check for distress progression with time
  - Each sample unit with time progression is valid data point

Rating Scheme and Percentages

Rating	Percent Good Data	Analysis Sections *
Excellent	>= 90 %	52 %
Good	75 % - 89 %	29 %
Satisfactory	50 % - 75 %	17 %
Poor	<= 49 %	2 %

* New construction only

Rating Scheme and Percentages



Excellent	$\geq$ 90 %
Good	75% - 89%
Satisfactory	50% - 74%
Poor	$\leq$ 49%

Advantages of PMS Data

- Volume of data available
- Many years of condition data
- Construction history mostly accurate
- MDOT has database-savvy PM personnel
- GIS-enabled, GPS coordinates
- Detail level of our distress data

Disadvantages

- Time-consuming
- Difficult to communicate
- Not easy to query for some attributes
- Iterative process
- Useable format
- Some samples don't show trends

Beyond PMS Data

- Much MEDPG desired data still manual
- Microfiche, construction project diaries
- Materials Division testing data
- Integration of traffic data still ongoing
- Construction & materials data not GIS-referenced

The Future

- Asphalt with overlays, then concrete
- Continue to work with ARA on local calibration with historical data
- New PMS software and optimization
- Future calibration to be done at project level on new construction projects
- MDOT will collect and process condition/distress data on new projects

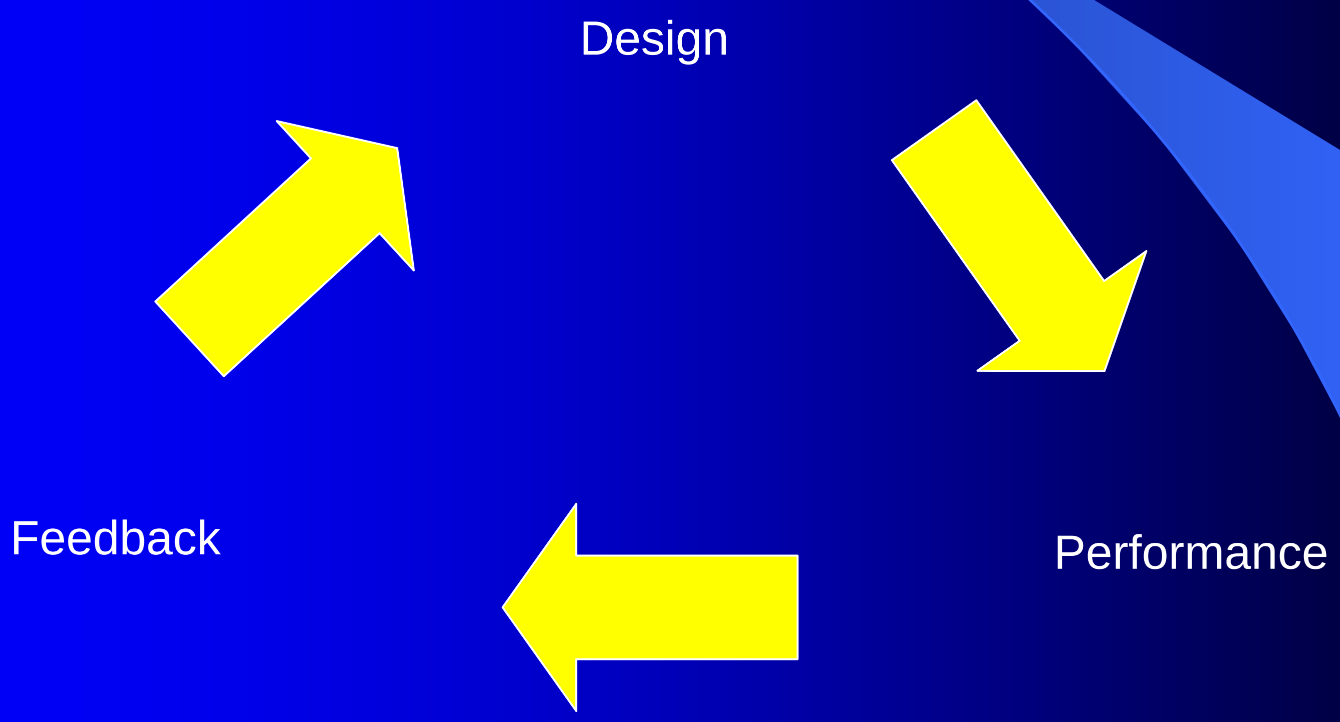
Implementation - Phase II

- SS No. 170 “Implement the 2002 Design Guide for MDOT (Phase II)
- Review inputs required by the MEPDG
- Complete design guide software sensitivity analysis
- Assemble data for calibration and validation of performance models

Lessons Learned So Far

- Communication is key
- Must have people who know data inside and out
- Must be able to get data into meaningful format
- PMS data best for initial calibration
- Each state must decide if and to what extent they can use their PMS data for MEPDG

Pavement Management and MEPDG



QUESTIONS?