



THE Louis Berger Group, INC.

Pavement Management Program

ALACPA Short Course on Pavements Maintenance



Course Objective

- Pavement Management Program
 - Benefits of a Pavement Management System
 - Components of a Pavement Management System
 - Commercial Pavement Management System Software
 - Management Levels
 - Report Generation and Usage





Airfield Pavement Basic Function

- Provide adequate bearing capacity
- Provide good riding qualities
- Provide good surface friction characteristics
- Other requirements
 - Longevity
 - Ease of maintenance



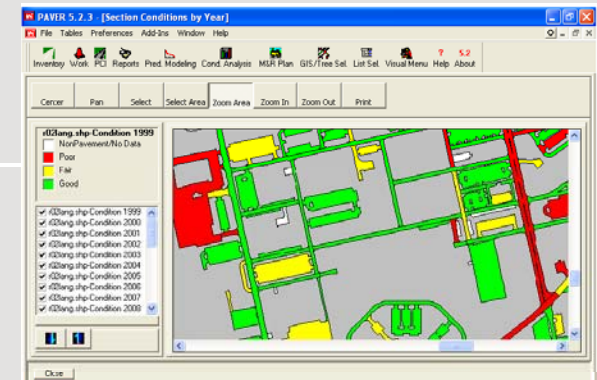
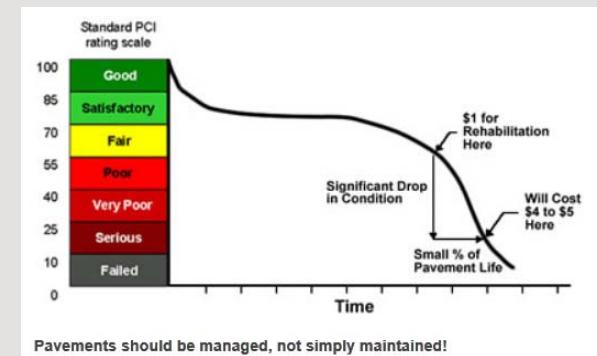
Benefits of Pavement Management Program

- Objective & consistent condition evaluation of pavement
- Systematic & documented engineering basis for determining maintenance and rehabilitation needs
- Identifying budget requirement at various levels of serviceability
- Documents current, historic and future pavement condition of the airfield pavement network
- Assist in the selection of life-cycle cost analysis for various maintenance and rehabilitation alternatives
- Identifies the impact on the pavement network as a result of not performing the required major repairs
- Identifying major and minor pavement repairs



Airport Pavement Management Program Theory

- An airport's Pavement Management Program (PMP) not only evaluates the current condition of the airfield pavements, but also predicts its future condition through the use of historic information and pavement condition indicators
- By projecting the rate of deterioration, a life cycle cost analysis can be made for various alternatives





Airport Pavement Management Program Theory

- Such analysis will help to determine the optimal time for applying the best alternative.
- Pavement generally performs well for the majority of its life, after which it reaches a “critical condition”, it begins to deteriorate quickly
- Studies have shown that maintaining pavement in “good condition” versus periodically rehabilitating “poor condition” pavement is four to five times less expensive
- Maintenance & rehabilitation solutions would be easy to plan if pavements exhibit clear signs that they have reached the “critical condition” point



Airport Pavement Management Program Theory

- The deterioration curve shape and the optimal maintenance and repair points vary greatly within a pavement network
- Due to the difficulty in determining when a pavement has reached its “critical condition”, the PMP can help identify the optimal rehabilitation point and help decision makers target available recourses where they will be most effective
- The PMP does this by making use of data collected from the pavement condition surveys and predicting future conditions and indicate whether the distress is an environmental or traffic load related



Cost Effective Solutions

- Information on pavement deterioration, by itself, is not enough to answer questions involved in selecting cost effective maintenance and repair program
- This type of decision requires information on the cost of various maintenance and repair procedures and their effectiveness; effectiveness means:
 - Solutions that target the source of the deficiency and will improve the pavement condition rating
 - Pavement will stay in this improved condition for several years to optimally recover the cost of the solution
- PMP will enable a user to store pavement condition and maintenance information into a database and use the resources to determine cost-effective solutions for the up keep of the airport pavement network



Components of the Pavement Management Program

- In order to take full advantage of the pavement management program, pavement condition information must be periodically collected and updated
- Alternative rehabilitation strategies must be identified along with the decision making criteria and maintenance policy that will determine which rehabilitation procedure will be employed
- The pavement management system must contain performance prediction models, cost alternative strategies, and optimization procedure that considers the entire pavement life-cycle



Components of the Pavement Management Program

- A system for accomplishing these objectives generally include:
 - System to collecting and storing information
 - Objective and repeatable system for evaluating pavement condition
 - Procedure for prediction of future pavement condition
 - Procedure for modeling historic and future pavement performance
 - Procedures for determining the consequences on pavement condition, life-cycle costing for a given maintenance and rehabilitation budget
 - Procedures for determining budget requirements to meet management objectives, such as maintaining a minimum condition
 - Procedures for formulating and prioritizing M&R projects



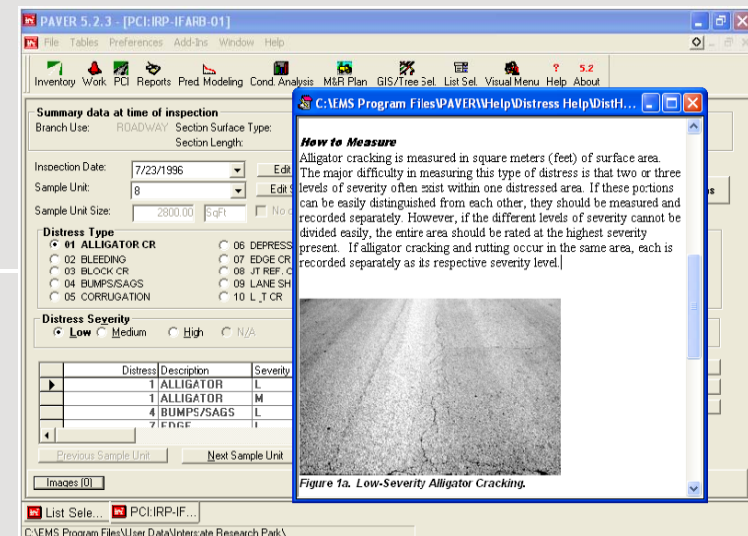
Essential Components of the PMP

- Data Base
 - Pavement Structure Inventory
 - Maintenance History
 - Traffic Data
 - Pavement Condition Data
- Capabilities
 - Predicting Future Pavement Condition
 - Optimum Maintenance & Rehabilitation Plans for a Given Budget
 - Budget/Financial Management
 - Prioritization of Maintenance & Rehabilitation Projects



Database

- Several elements are critical in making good pavement repair decisions:
 - Pavement Structural Inventory
 - Maintenance History
 - Pavement Condition Data
 - Traffic Data





Pavement Structural Inventory

- Starts with mapping the airfield pavement structural composition (material and thickness), subsequent overlays, rehabilitation, etc., is the key to analyzing problems and design solutions
- “Asbuilt” records should provide this information; if they are not available or if the records are suspected to contain erroneous information, coring of the pavement section (top of surface into the subgrade) at multiple locations will be required to prepare a realistic pavement sectional profile



Pavement Inventory

- Obtain a topographic survey as the base
- Obtain pavement condition and index values from the conception of the airfield (if available)
- Create a map for all of the inspection performed from the conception or rehabilitation to current date
- Input this data into the PMP model



Pavement Maintenance History

- History of maintenance performed and its associated cost will provide valuable information on the effectiveness of various maintenance procedures on the different airport pavements
- The cost of each maintenance project is necessary when performing lifecycle analysis
- At a minimum the following information should be collected and placed into the PMP
 - Documentation of Reconstruction/Rehabilitation and all repairs
 - Historic Inspection Reports, PCI, PCN, field notes and associated drawings and maps



Traffic Data

- Data about the number of daily operations and type of aircrafts using the pavement is necessary when analyzing probable causes of the deterioration and when to consider alternative M&R procedures
- Historic traffic data at each inspection cycle should be logged into the PMP



Pavement Condition Data

- A fundamental component of any pavement management system is the ability to track historic and current pavement condition
- This requires an evaluation process that is objective, systematic and repeatable
- A pavement condition rating system-such as the pavement condition index (PCI) rating system described in *ASTM D5340, Standard Test Method for Airport Pavement Condition Index Survey* along with the *FAA AC 150/5320-6 Airport Pavement design and Evaluation, Chapter 6* for determining the pavement classification number (PCN) provides a systematic pavement rating system that can be utilized consistently throughout every pavement survey
- Periodically collecting condition data is essential for tracking pavement performance, modeling pavement performance and determining when to schedule M&R



Program Capabilities

- The PMP must be capable of providing the following:
 - Predicting future pavement condition; condition predictions are necessary in developing optimum, multiyear M&R plans
 - Producing optimum maintenance & rehabilitation plans that identifies where and when M&R is required and approximates how much it will cost; This data will assist in setting priorities that fit the predetermined M&R budget
 - Determining budget requirements meeting the specified management objectives. Typically management objectives include maintaining of pavement above a specific condition and eliminating M&R requirements over a specific number of years
 - Developing optimum maintenance & rehabilitation plans at a section level; should facilitate the formulation & prioritization of M&R projects; Engineering judgment remains a key component in transforming the optimum M&R plan into a practical executable project



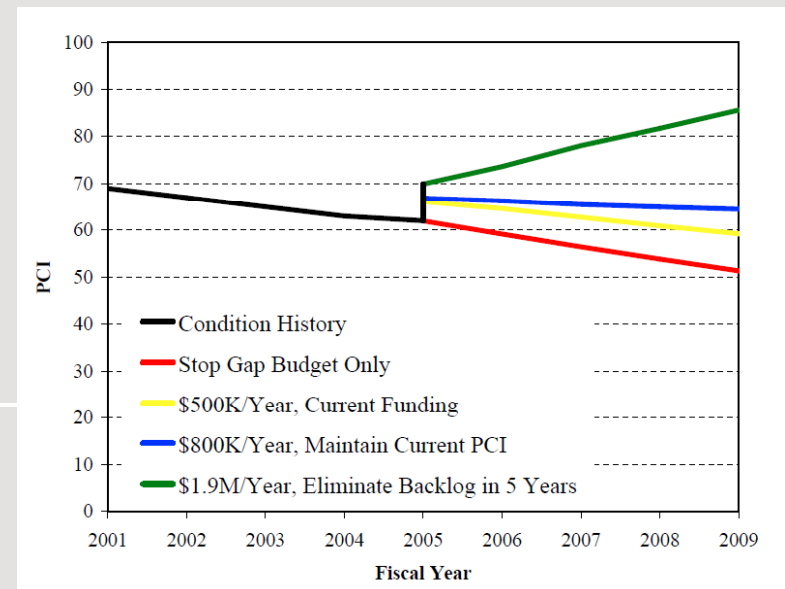
Pavement Management System Software

- Several Pavement Management Software (PMS) options exist for the development of an electronic Airport's Pavement Management Program
- Applications created by the USACE Construction Engineering Research Laboratory, such as PAVER™ provides an excellent platform to store, manage, analyze and generate reports of the historic, current and predictions of the airport's pavement network condition
- Cost about \$800 USD for three users, best investment for the airport engineer



Management Levels

- Managing a PMP effectively requires decision making at two levels:
 - Network Management Level
 - Project Management Level





Management Levels

- Network Management Level - addresses the short-term and long term budget needs, the overall condition of the pavement network, and sections to be considered at the project level; Decisions are made to manage the entire pavement network
- At this level the use of PMS provides automated tools for storing and analyzing pavement condition information; customized reports addressing critical sections and forecasting budget will help decision makers become more effective in solving the pavement needs within a specified budget
- Condition prediction at this level involves the basis for developing the inspection schedules & identifying pavement requiring M&R; once the pavement network needs are identified a current year budget and future M&R budgets can be composed, and funding needs addressed



Management Levels

- Project Management Level – decisions are made about cost effective M&R alternatives; at this level the pavement condition is surveyed in great detail; non-destructive, destructive load bearing test along with the PCI and friction surveys have been performed, recorded and analyzed, and are used to scope the project
- At this level the overall condition of the pavement should be taken into account, the structural integrity, the surface condition along with the surface texture levels; it is extremely important that once a project is determined that all of the failing components are addressed
- Use of PMS to quantify a number of engineering measurements of the pavement condition is ideal at this level; pavement structural testing and condition survey results can be entered into the database and reports extracted that quantifies the specific project goals and budget



Report Generation and Usage

- Regardless if the airport's engineering team is using a PMP software or not, decision making reports need to be created and distributed to those in charge of allocating funds and authorizing the works. The recommended minimum set of reports are as follows:
 - Inventory
 - Inspection Scheduling
 - Pavement Condition
 - Budget Planning
 - Network maintenance
 - Economic Analysis



Report Generation and Usage

- Inventory Report – list all of the pavement networks and contains information such as:
 - pavement type (PCC or HMA)
 - surface type (grooved or non-grooved)
 - Pavement function (taxiway, runway, apron)
 - Location
 - Area
- Overall the inventory of the pavement network is similar to a topographic survey, but without the details, its main purpose is to provide the outline areas of the airport's pavement



Report Generation and Usage

- Inspection Scheduling – reports the schedule of inspections based on minimum acceptable condition levels and deterioration rates
- Additionally, it helps the PMP manager schedule inspection at “critical condition” level or at constant periodical time lines



Report Generation and Usage

- Pavement Condition – report provides a tabulated pavement condition assessment of the historic, current, and future years
- Report provides the condition of the individual pavement segments and the overall pavement network.
- Projected condition are presented and utilized in planning M&R needs and to inform management of the present and future condition of the pavement, with selected alternatives (repair, rehabilitation or do-nothing)



Report Generation and Usage

- Budget Planning – projects the budget required to maintain the pavement network at or above the user specific condition level
- The report should predict the year in which minimum pavement conditions are reached and provides the projected budget for such repairs or rehabilitation, to obtain this the report must draw the following data:
 - Minimum pavement condition (PCI) for each pavement type and use
 - Average unit repair cost based on similar surface and PCI ranges, and
 - Inflation rate during the analysis period



Report Generation and Usage

- Network Maintenance – is the airport's maintenance strategy
- Which applies the pavement database of information to identify the distress levels in the latest PCI survey
- It can be used to estimate both the type and cost of routine maintenance for the development of the annual workplan



Report Generation and Usage

- Economic Analysis – report consists of the most cost-effective alternative for pavement repairs.
- Each feasible alternative, initial cost, periodic maintenance cost, one-time future maintenance cost, interest rates and discount rates are presented
- A life-cycle analysis is performed for all alternative repairs
- The analysis includes various interest rates, repair cost, and timing and their effects on the alternatives



In Closing

- Using funds most efficiently requires good planning and accurate identification of appropriate rehabilitation projects
- Assessing pavement conditions is an essential first step in this process, yet the proper management and analysis of the pavement survey is critical in making sound decisions
- An Airport Pavement Management Program provides the airport's engineer with historic, current and futuristic predictions of the pavement network condition, maintenance and repair cost
- By having a centralized PMP, the search for data is easily available, the analysis of the data is readily performed, and the execution of the works is properly planned
- The "Guessing" of when the works is needed is now replaced with a systematic, logical and cost effective approach



References

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- Antiskid Surfacing Prevent “Slippery When Wet Conditions” At an International Airport – A Case Study, by W.H. Walker Consulting Engineer, Pavement & Materials Volker & Partner, Kaenerbergstr. 40, 57076 Siegen, D
- Performance of Grooved Bituminous Runway Pavement, by Alex K. Apeagyei, Imad L Al-Qadi, Hasan Ozur & William G. Buttlar, University of Illinois Dept of Civil & Environmental Engineering 1212 NCEL, MC-250, Urbana, IL 61801



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Forum for Open Discussion

