International Journal of Structural and Civil Engineering Research

ISSN 2319 – 6009 www.ijscer.com
Vol. 2, No. 4, November 2013

Research Paper

PERPETUATION OF AIRPORT PAVEMENTS

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The need to Perpetuation our airfield pavement infrastructure is paramount to insuring the viability of transportation of people and goods. Preventive maintenance plays an important role in the Perpetuation of airfield pavement infrastructure. A successful preventive maintenance program cannot function without the support of many features associated with pavement management systems (e.g., pavement inventory, condition assessment, and the framework for the identification and prioritization of pavement preservation treatments). The purpose of a preventive maintenance treatment is to prevent premature deterioration of the pavement, retard the progression of pavement defects, and cost-effectively extend the life of the pavement. The objective is to slow down the rate of pavement deterioration and effectively increase the useful life of the pavement. A preventive maintenance treatment is not determined by the type of treatment, but by the reason why the treatment is performedThe effectiveness of preventive maintenance is largely dependent on the timing of maintenance activities. The development and implementation of a preventive maintenance program should be done in a collaborative manner, and should be supported by training and educational activities. Perpetuation in essence, is caring about the future condition of the world we live in. The decisions we make today have consequences on our environment tomorrow. They are either positive or minimal in nature, or they are large and far reaching and very negative, and we have to live with it. The legacy we leave for our children and grand children will determine if we were good stewards of what we had been given. Perpetuation is the "long-term" philosophy that shows we recognize these important environmental issues.

Keywords: Perpetuation, Estimation, Environmental issues

INTRODUCTION

Pavement Preservation

Pavement perpetuation represents a proactive approach in maintaining our existing highways. It enables State Transportation Agencies (STAs) to reduce costly, time-consuming rehabilitation and reconstruction projects and the associated traffic disruptions. With timely preservation, we can provide the traveling public with improved safety and mobility,

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reduced congestion, and smoother, longer lasting pavements. This is the true goal of pavement preservation, a goal in which the FHWA, through its partnership with the States, local agencies, industry organizations, and other interested stakeholders, is committed to achieve.

Categories of Pavement Preservation

Why the Interest in Pavement Preservation?

- Airport Pavements - a Huge Investment
- Important to Preserve Investment
- Effective Pavement Preservation Program:
  - Right Pavement
  - Right Treatment
  - Right Time

Figure 1: Pavement Preservation

Pavement Condition vs. Time

This curve demonstrates the importance of selecting the "right time" for pavement treatments. We want to be programming most of our work at this stage (point to $1 spot), to avoid having to do the more expensive work here ($4 spot)

Figure 2: Categories of Pavement Preservation

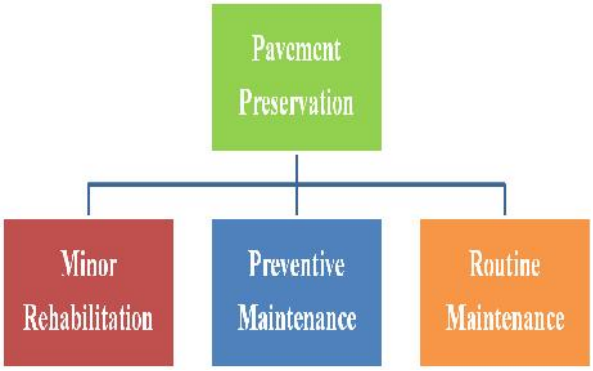
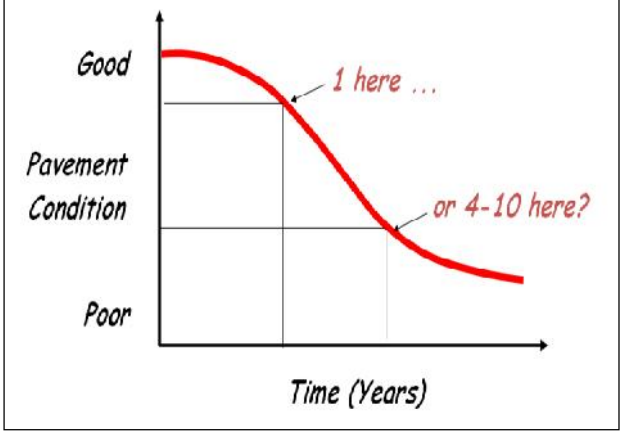


Figure 3: Pavement Condition vs. Time



Traditional Approach

The traditional approach allows pavements to deteriorate until the condition reaches such a point that major rehabilitation is req'd.

Some agencies have based their operations on the premise that "if it aint broke; don't fix it". They may say we can only afford to fix the very worst pvmts. In the end this approach costs MORE MONEY

- Allows deterioration to fair to poor conditions.
- Major rehabilitation or reconstruction required.

- Clearly reactive, time consuming and costly.

Figure 4: Rehabilitation or Reconstruction

Proactive Approach

A true preservation approach involves the application of a series of successful low cost, preventive maintenance treatments that individually will last for several years.

The key is to apply the right treatment at the right time. This means applying it to the candidate pavement when it is still in good condition and there is no structural damage.

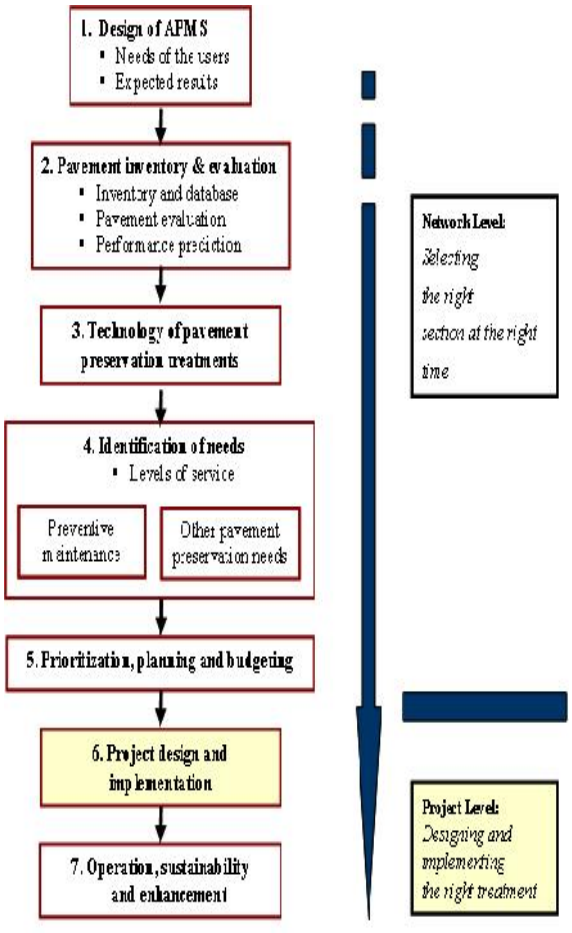
Once structural damage has occurred then preventive maintenance treatments are of little value.

Applying PM treatments to unsuitable pavements has been its biggest barrier to gaining widespread acceptance for the PM concept.

- Applies low-cost preventive treatments.
- 5 to 7 year life.
- Timing is critical Good Condition, No structural damage.

Main Components of Airport Pavement Management

Figure 5: Main Components of Airport Pavement Management



Step 1: Design of APMS

When 1st implementing a PMS, or when considering how to improve the one you have, there are some "management" aspects to consider.

- Who will operate the PMS- will it be done by in-house staff or by a consultant?
  - It is important to secure an adequate budget to implement and continue operation of the PMS (benefits will increase over time, so this shouldn't be viewed as a one-time project when setting a budget.)
  - To be successful, the PMS should be integrated (not separate from) your decision making process and supported by upper management.
  - Management Considerations:

    Decide who will operate

    Budget for operation

    Integration into decision making

    Support by upper management departures of each A/C type) for each section.
  - Pavement structure
  - M&R history
  - Pavement condition
  - Traffic data

Step - 2: Pavement Condition Data

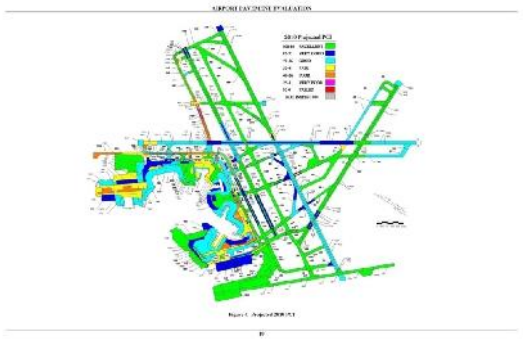
- Inventory = basic building block of APMS
- Sectioning of network
  - Homogeneous units
  - Similar pavement structure and condition
  - Basic unit for decision making (repair unit)

Sectioning at Small Airport

Figure 6: Sectioning at Small Airport

Sectioning at Large Commercial Airport

Figure 7: Sectioning at Large Commercial Airport



- Inventory information for each section:
- For each section, it is useful to input info on the pavement composition (structure) and its maintenance history. Sometimes this is not readily available at the outset, but can be populated over time. Pavement condition is an essential element of the PMS that we'll discuss in a moment. For any airport that has some variation in traffic throughout the facility, it is important include

traffic data (i.e., annual departures of each A/C type) for each section.

- Pavement structure
- M&R history
- Pavement condition
- Traffic data

Pavement Condition Data

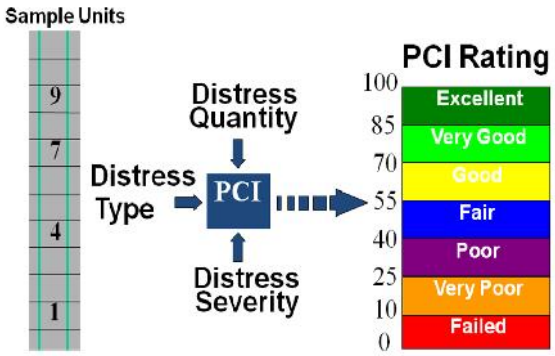
- As a minimum, Condition Data consists of type, severity and quantity of distress. ASTM method identifies 16 distress types for AC and 15 distress types for PCC. Some A/P's also collect roughness, friction and structural data.
- Optional Discussion- only about half dozen that are predominant at most airports, that affect pvmt preservation needs (for AC- L&T; rut; weathering; block; jet blast; oil-spill); for PCC-Jt seal; Jt spall; Fault; corner break; L- cracks. FOD applies to both AC & PCC and is an important consideration in M&R selection.
  - Surface Distress (PCI Method)
  - Roughness
  - Friction

Figure 8: Pavement Condition

Pavement Condition Index PCI Method

The distress data is then used to calculate an overall Pavement Condition Index (PCI), which is a scale from 0-100 as shown.

Figure 9: Pavement Condition Index



Survey-Pavement Characteristics Evaluated

	Runways		Taxiways and Other Facilities	
Pavement Characteristic	**Usage %**	**Average Frequency (Years)**	**Usage %**	**Average Frequency (Years)**
Pci	78	3.4	54	3.3
Roughness	12	N/A	4	N/A
Friction	22	N/A	8	N/A
Fwd Testing	18	3.7	12	N/A

What does our survey say, About pvmt characteristics typically evaluated: 78% do a PCI survey on R/W's; a small % collect info on roughness, friction and structural strength (as determined by FWD testing). You can see there are different #'s for T/W's and other facillities. Take note that the avg. frequency of surveys is about 3 years. I'll comment on that

later.

Evaluation for Preventive Maintenance

Evalns can be made specifically for PM – i.e., determine when it should be applied. Ideally should be at time when most effective (type before distress progresses and more expensive treatment needed. The ideal time to take care of the single crack shown on left(e.g., route and seal) is Now; not 1-2 years from now when multiple cracks have formed and begun to ravel. The crack on Left could progress to condition on Right is just a couple of years.

- Consequently, cond surveys should be done annually to catch pvmts at right time
- Survey says– avg. 3 year cycle (range 1-10 years). ***This is an area for improvement***
  - PM should be applied when most cost-effective
  - Condition surveys ideally done annually

Figure 10: Ideal Time for Crack Filling

Past ideal time

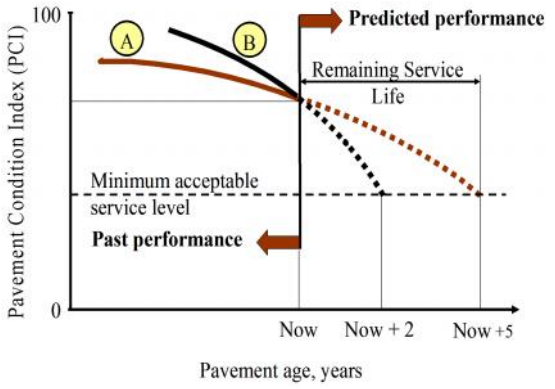
  - Survey- avg frequency of PCI survey = 3 years

Performance Prediction

Since planning and budgeting for 5 or more years, it's necessary to estimate future pvmt preservation needs, so we need to predict future conditions.

- Figure shows pavements A and B with same current PCI, but B predicted to deteriorate faster than A, so it needs treatment sooner
- How do we know B will deteriorate faster than A?- there are several methods available to predict future conditions—many are based on "family modeling",
  - Typical planning period = 5 years

Figure 11: Performance Prediction



  - Need to predict future conditions
  - Several methods (many based on "family modeling")

Step 3 - Technology of Pavement Treatments

- Selecting appropriate treatments is important part of pavement management

Figure 12: Pavement Treatments

- Synthesis contains Catalog:
  - 24 AC treatments
  - 24 PCC treatments

Step 4 - Identification of Needs

- Based on condition surveys, performance predictions, and criteria built into APMS
- Criteria based on 3 concepts:
  - Maintenance policies
  - Level of service
  - Trigger values
- MicroPaver identifies 2 levels of needs:
  - Localized maintenance and repair

    Year 1-specific treatments based on distresses

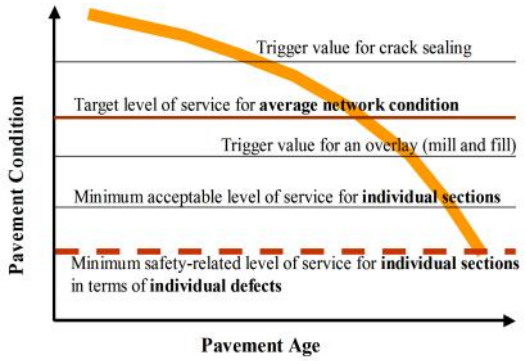
    Future years- $ based on PCI ranges
  - Generalized major M&R

    Unit $ based on PCI level

Level of Service Targets

This graphic shows the use of all of the potential DECISION CRITERIA mentioned earlier.

Figure 13: Level of Service Targets



- A specific PCI level can be programmed into the APMS so that a treatment such as crack filling (high PCI level) or Overlay (lower PCI) are “triggered”.
- A target level (PCI) can be established for the overall network and M&R programmed over a period of years to achieve this goal.
- Similarly, a Min acceptable LOS for individual sections can be input so that treatments are programmed when the pvmt falls below this level.
- Often the person developing a CIP may run reports using several of these criteria, then develop a final CIP based on some combo of these. Minimum safety-related levels of service are typically defined in terms of individual pavement defects, such as potholes, cracking, and wheel track rutting.

The minimum acceptable level of service is the minimum condition for individual pavement sections. The sections at or below this level should be improved at the first opportunity.

Trigger values are usually associated with specific pavement preservation treatments (such as sealing cracks in asphalt concrete

pavement or sealing joints in concrete pavement) and are related to the need to apply a preservation treatment at the right time to be effective, or before the pavement reaches a condition where a different, more expensive treatment would be required.

Target levels of service represent a desirable level of service for the entire pavement network or a portion of the network.

Step 5 - Prioritization, Planning and Budgeting

- Short Term
  - Simplified analysis- no future M&R alternatives
  - Establish priorities based on:
    - Safety
    - Cost-effectiveness
    - Critical condition level
- So, we talked about Short and Long- term planning, Now, back to short vs long-term prioritization:
- SHORT TERM-alternative future alts not considered
- Priorities can be set based on SAFETY (e.g., if distresses with FOD potential-high priority to fix); COST EFFECTIVENESS-typ favors projects that can be done before significant damage occurs – in other words-preventive maintenance; CRITICAL LEVEL OF SERVICE or condition level - unlike PM, this essentially means a "worst first" prioritization which is usually the reverse of the $-effectiveness approach, but airports are still reqd to provide for safe aircraft operations and to provide a min. level of service, therefore, short-term planning budgets typically combination of each. Separate priority lists can be created then selections made from each, applying some judgment.
- Long-Term:
  - Multi-year prioritization of alternative treatments
  - Typically based on cost effectiveness
- Long term-programmed treatments in the "out years", are not based on immediate safety problems and alternatives are selected based on their $-effectiveness (explained further on next slide)

Figure 14: Budget Development Process

Budget Development Process

Step 5 - Budget Evaluation

- Budget Evaluation Tools:
  - Monitoring performance trends
  - Monitoring expenditures over time
  - Tracking backlog of un-funded preservation needs
  - Evaluating consequences of budget levels on future conditions

Step 6 - Project Design and Implementation

- Design:

  - Network level APMS- provides multi-year M&R program
  - Project level APMS- provides final treatment and technical details
- Implementation and Monitoring:
  - APMS useful to monitor M&R performance
- Survey
  - Only 45% using APMS to monitor performance of past M&R

Step 7 - Operation, Sustainability and Enhancement

- Success of pavement preservation program and its sustainability closely linked
- Document and communicate successes to top management
- Seek sustained preservation funding

Preservation Techniques

Several maintenance/rehabilitation methods are available to the agencies responsible for managing and protecting the pavements. They include:

Preventive maintenance—used to preserve the pavement in good condition and can include the following treatments:

Crack sealants,

Fog seals,

Chip seals,

Slurry seals and microsurfacings, and

Thin hot-mix overlays.

To achieve best results for all treatments, proper techniques and mixing methods must be followed.

CONCLUSION

- Preservation in essence, is caring about the future condition of the world we live in. The decisions we make today have consequences on our environment tomorrow. They are either positive or minimal in nature, or they are large and far reaching and very negative, and we have to live with it. The legacy we leave for our children and grand children will determine if we were good stewards of what we had been given. Preservation is the "long-term" philosophy that shows we recognize these important environmental issues
- When pavements deteriorate to fair or poor condition they require rehabilitation to repair structural damage and restore pavement conditions—a costly, time-consuming activity. Hi-Lite will help plan treatments for minimal disruption of normal activities.
- Reduces pollution and the demand for finite resources.
- Increases the sustainability of a significant national asset.
- Is environmentally responsible.
- Is ultimately cost-effective.

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