



Proactive Airport Pavement Management: The Tools Are Available

Prepared for the ICAO-ACI/LAC Conference

Lima, Peru

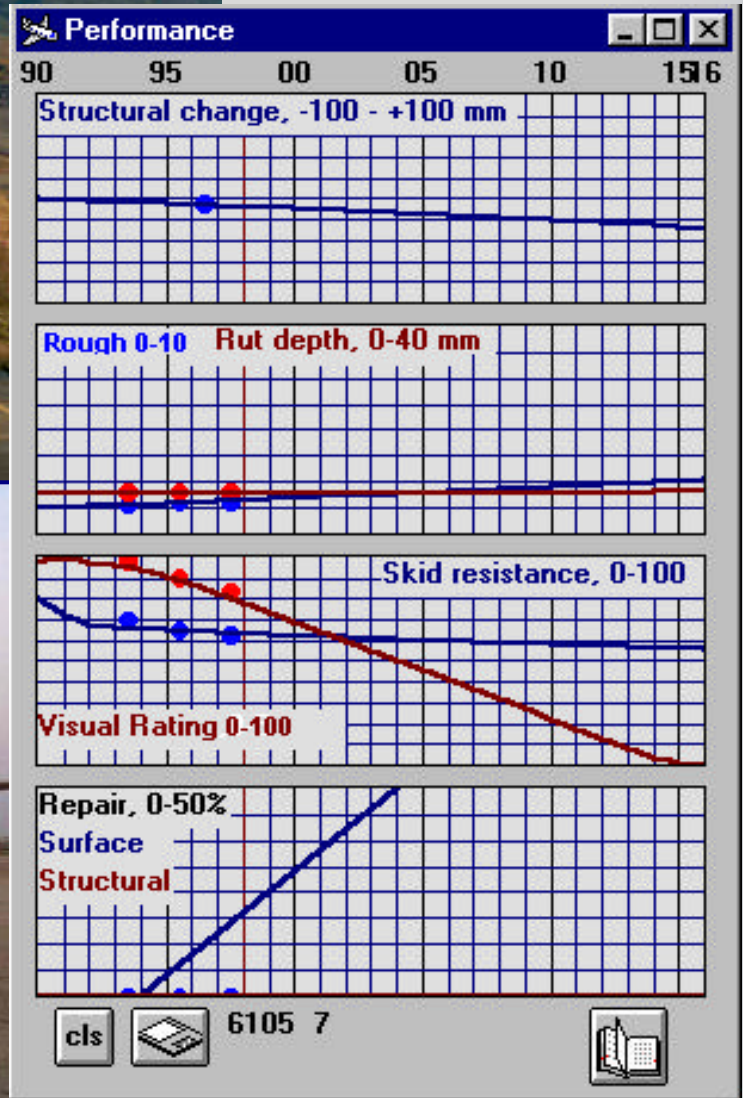
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By

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Types of Evaluations

- Windshield survey
- Pavement Condition Survey (PCI)
- Structural Evaluation (NDT)
- Combinations of the above



Windshield Survey

- Reactive
- Typically maintenance related
- Performed by Operations or Maintenance
- See it – Fix it



Pavement Condition Survey (PCI)

- Most widely used pavement inspection procedure in the world
- **FAA Circular AC:150/5380-6
Guidelines and Procedures for
Maintenance of Airport Pavements**
- **ASTM D-5340 Standard Test Method
for Airport Pavement Condition Index
Surveys**



Pavement Condition Survey (PCI) cont'd

- **Visual inspection of the pavement**
- **Identification of surface distress relating to:**
 - **Age**
 - **Environment**
 - **Load**
- **Calculation of the PCI value**



Pavement Condition Survey





PCI Survey





PCI - Reactive or Proactive?

- Identifying **current** distress types
- Quantifying **current** distress types
- Monitoring progress of distress
- Predicts future PCI not future distress type, severity or quantity
- Sometimes when you see it it is too late!



Asphalt Examples

- L&T Cracking – Age related
- Alligator Cracking – Load related
- L&T Cracks start from Top surface
- Alligator Cracks start from Bottom surface
- Rutting visible in surface, may start from bottom



Concrete Examples

- Corner Breaks – Load related
- Shattered Slabs – Load related
- L&T Cracks may be start of load related problems



Proactive PMS

- Why?
- Inputs?
- Modeling
- Advantages
- Disadvantages



Why?

- Need to budget more accurately
- Understand the pavement structure
- Predict pavement performance more accurately
- Take advantage of new technology



PMS Inputs

- Moduli
- Roughness
- Layer thickness
- Visual condition
- Operations
- Friction
- Budgets

Friction





Typical Self Contained CFME Runway Testers in use





Typical Trailer type CFME Runway Testers





Dynatest 6850 Runway Friction Tester

- FAA ICAO certified
- Self contained
- Windows software
- 23,000 Feet test capacity
- Optional GPS
- Optional remote data link
- Optional Texture laser



Roughness

- **Influences the maintenance of aircraft**
- **Influences pilot complaints**
- **Not commonly collected presently**
- **Can be tied to construction specifications**
- **Can be used by only a few Pavement Management Systems**

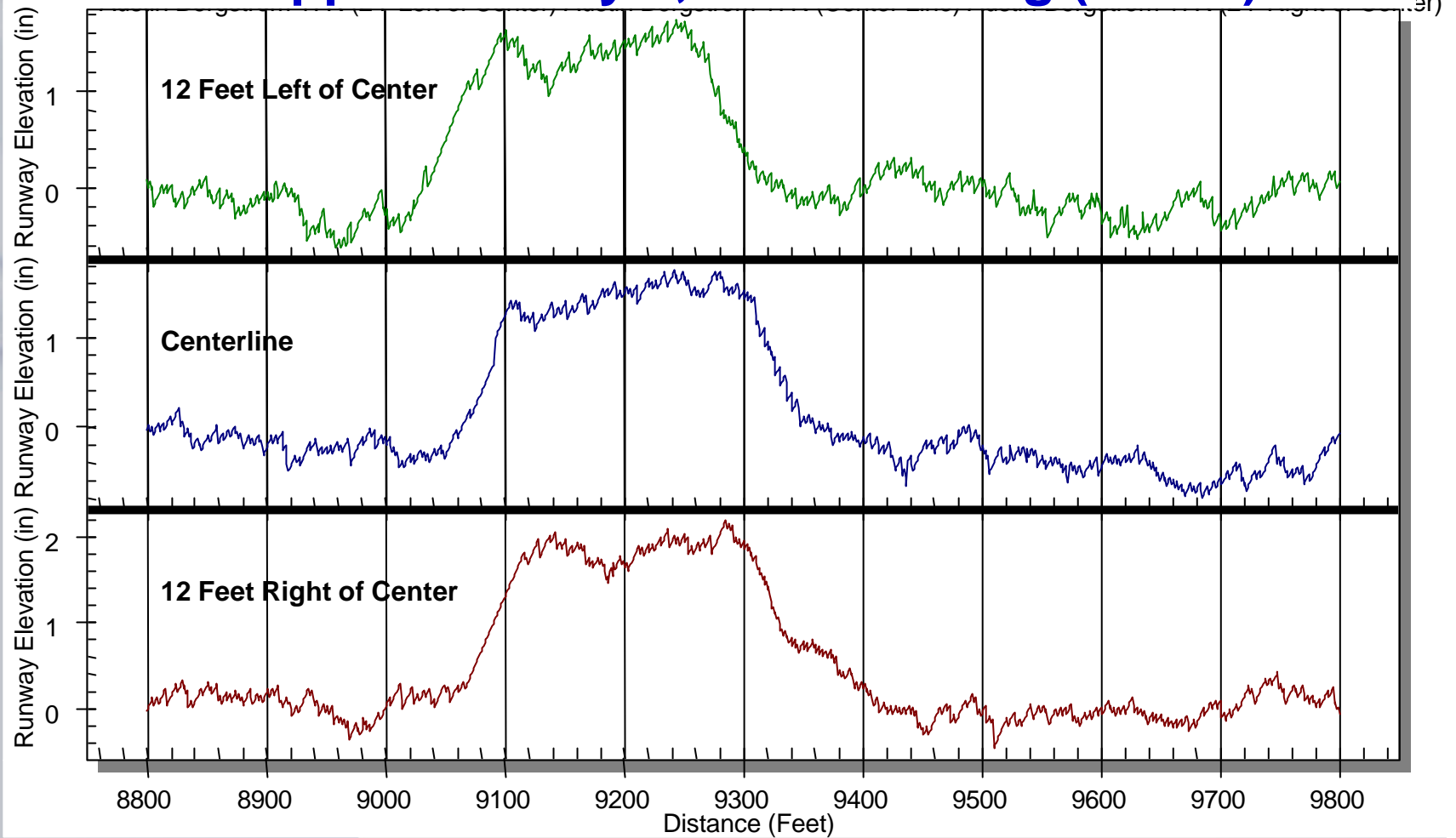


RSP





Three Lines of Survey, Approximately 1,000 Feet Long (300 m)





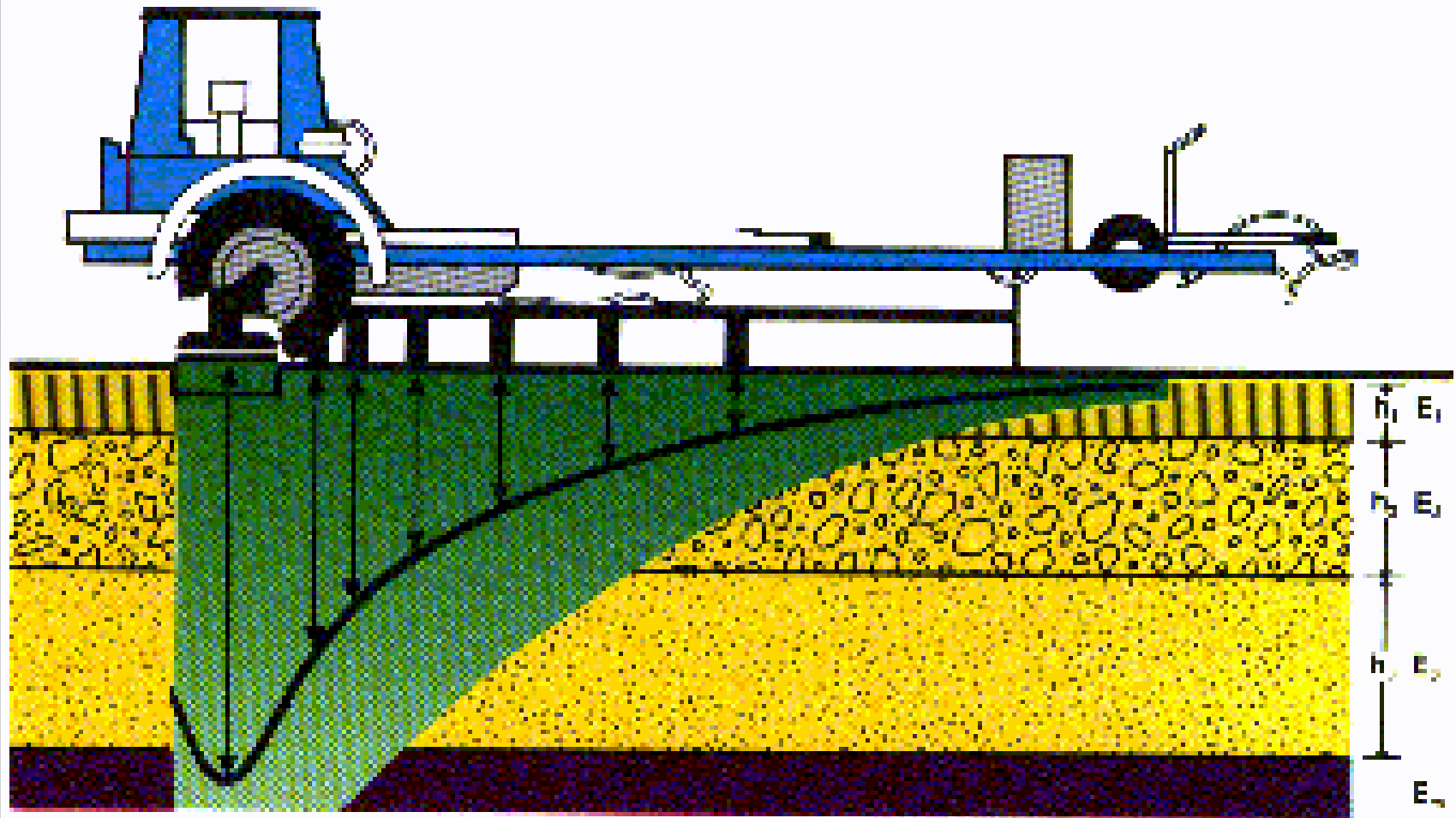
Deflection





NDT





New Aircraft

Aircraft Details

Aircraft name:

Gear Type:

Max Gross main load (N):

Percentage Load on one main Gear:

Tire Pressure (MPa):

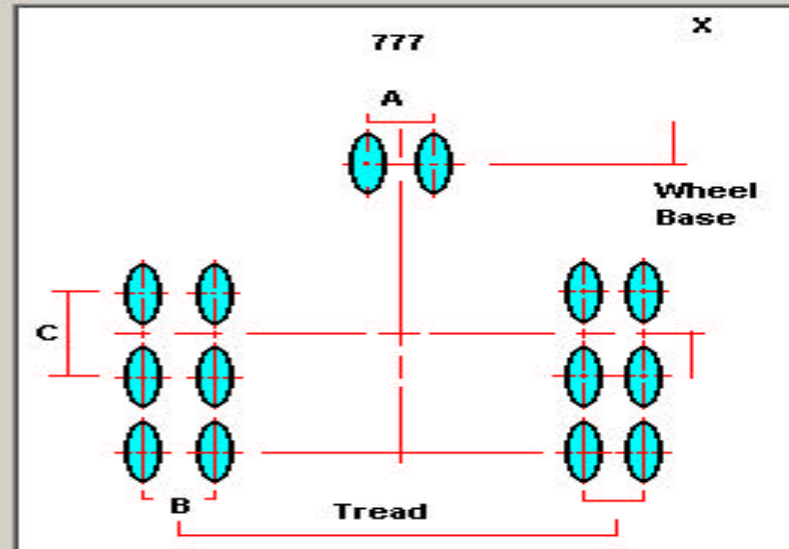
C - Axle Distance (cm):

D - Wheel Distance (cm):

Tread Distance (cm):

Number Main Gear Legs:

Tires per Leg:





Proactive PMS System Requirements

- Model the Structural performance of the pavement
- Model the Functional performance of the pavement
- Model the Roughness of the pavement
- Model the Friction characteristics of the pavement
- Provide realistic economic planning
- GIS linkage



Proactive Modeling

- Environmental/materials related distresses are aggravated by traffic loading
- Mechanistic models can be used to predict the onset of load associated distresses
- Structural modeling introduces a proactive process into the PMS.

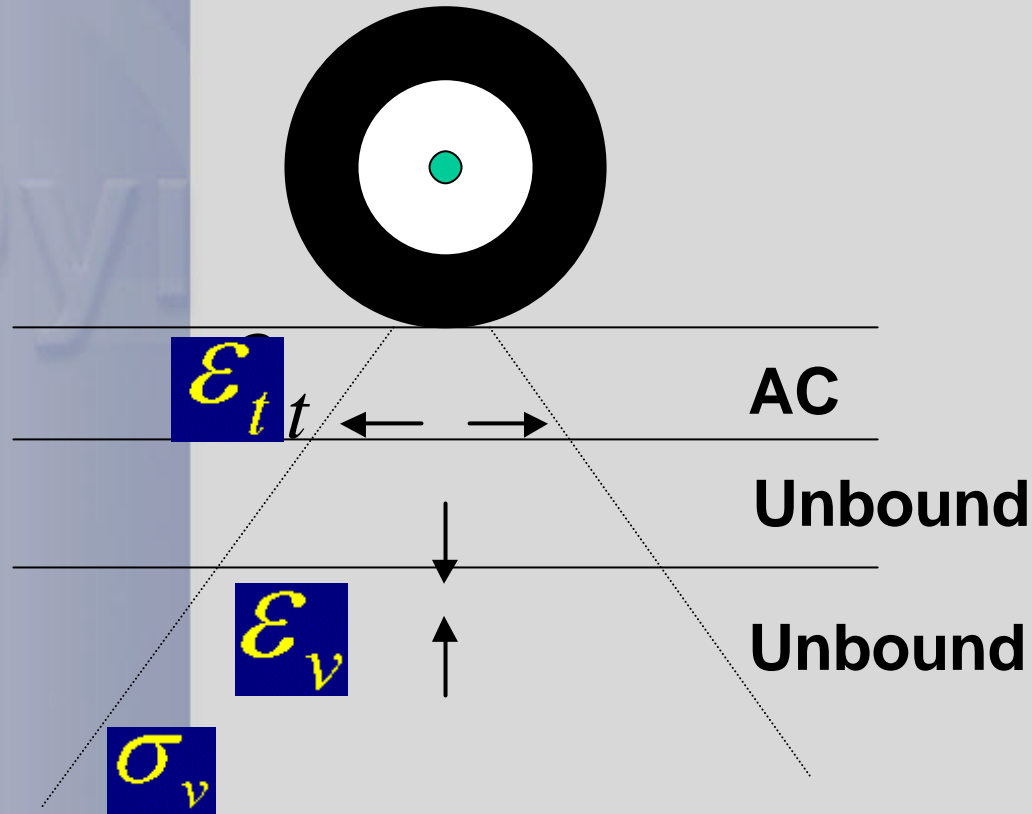


Proactive Modeling cont'd

- PMS which do not consider structural performance of pavements are overlooking a vital component of the pavement deterioration process.
- PMS should utilize structural info at the network and section level for project selection, prioritization, and optimization.

Mechanistic Models

- Odemark/Boussinesq equations
- Miner's Law for damage





Damage Functions

- Decrease in AC & cemented modulus (cracking)
- Rutting of unbound layers (permanent deformation)
- Roughness
- Decrease in Skid Resistance



Damage Functions

Material type and deterioration functions

Asphalt	Ref. modulus	3600	Minimum	500	Sdf	1.2
Seasonal factors	1					
Damage functions						
dE/Eo =	0.5	{N/10 ⁶ [strain / 268 (E/ 3000)	0	5.29	}	1
Rough. =	1	{N/10 ⁶ [strain / 1350 (E/ 160)	0	4	}	1
Rut =	1	{N/10 ⁶ [strain / 885 (E/ 160)	0	4	}	1
Skid =	60	{1- 0.1 (contact stress/ 0.7)	1	(N/10 ^{6<td>0.5</td><td>}</td>}	0.5	}
Expected life as wearing course	14					
Age: multiply modulus by (1	+ -0.0 *age in years)	0.4			
Water: multiply modulus by	0	if moduli of bound layers	0	Eref		
Environmental effects: 1 for bituminous, 2 for cement, 3 for unbound	1					
Save	Add	Next	Previous	Delete	Quit	



Rehabilitation Alternatives

M+R alternative

PM8

Price/m2 WC/m2

Thickness removed

	Material	Thickness
Layer 1	Asphalt	40
Layer 2		
Layer 3		
Layer 4		

Decrease in Roughness	<input type="text" value="1.5"/>	min	<input type="text" value="1.05"/>
Increase in skid resist	<input type="text" value="70"/>	max	<input type="text" value="70"/>
Decrease in rut depth	<input type="text" value="50"/>	min	<input type="text" value="1"/>
Increase in PCI	<input type="text" value="60"/>	max	<input type="text" value="100"/>
Dcr. sdf exist bound	<input type="text" value="0"/>	min	<input type="text" value="0"/>
Incr. envr.fact unbound	<input type="text" value="0"/>	max	<input type="text" value="0"/>
Incr. residual life, exist	<input type="text" value="0"/>	max	<input type="text" value="0"/>
Incr. residual value	<input type="text" value="0"/>		

Construction time, days/km

Preparatory surface repair %

Preparatory structural repair %

Save

Add

Next

Previous

Delete

Quit

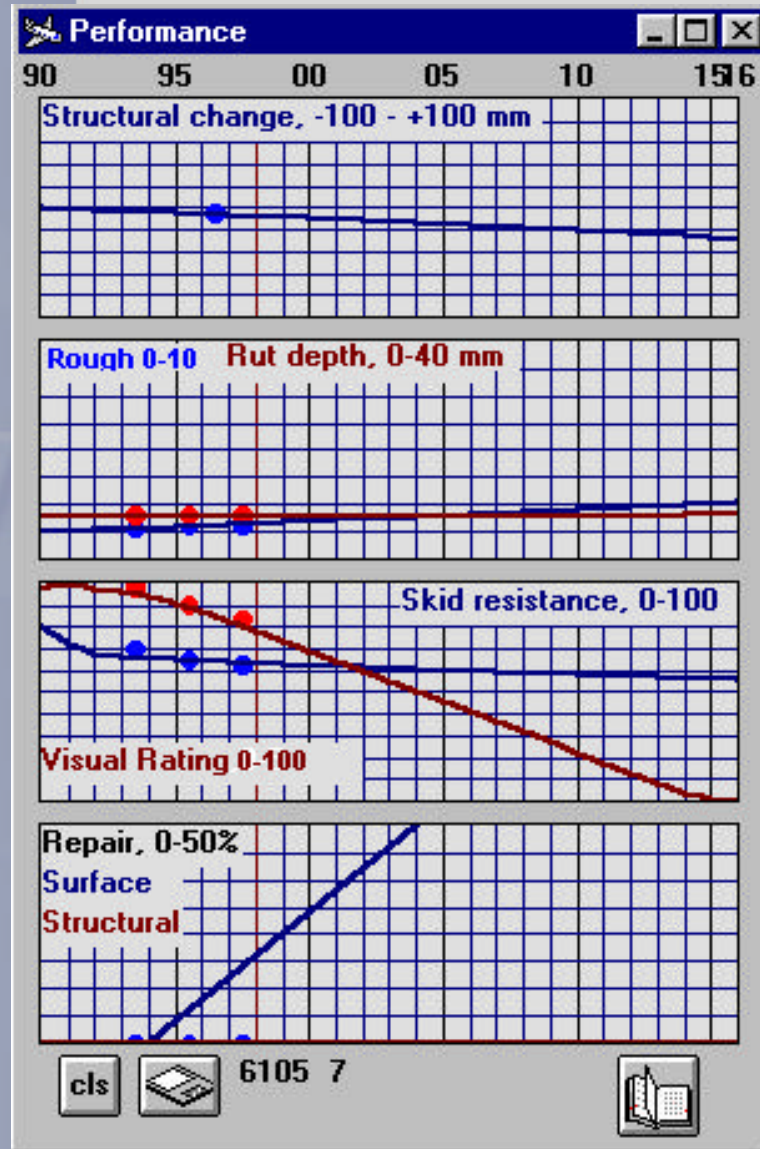


Optimizing at the Section Level

- All M&R Measures evaluated on each section which meet user specified limits on:
 - Decrease in AC modulus (cracking)
 - Roughness
 - Rutting
 - Skid Resistance
 - Residual life of surface course
 - Visual Rating PCI
 - Percent area in need of repair (patch)
- Measures not meeting above requirements are discarded
- Measures with high agency costs are discarded



Performance Modeling



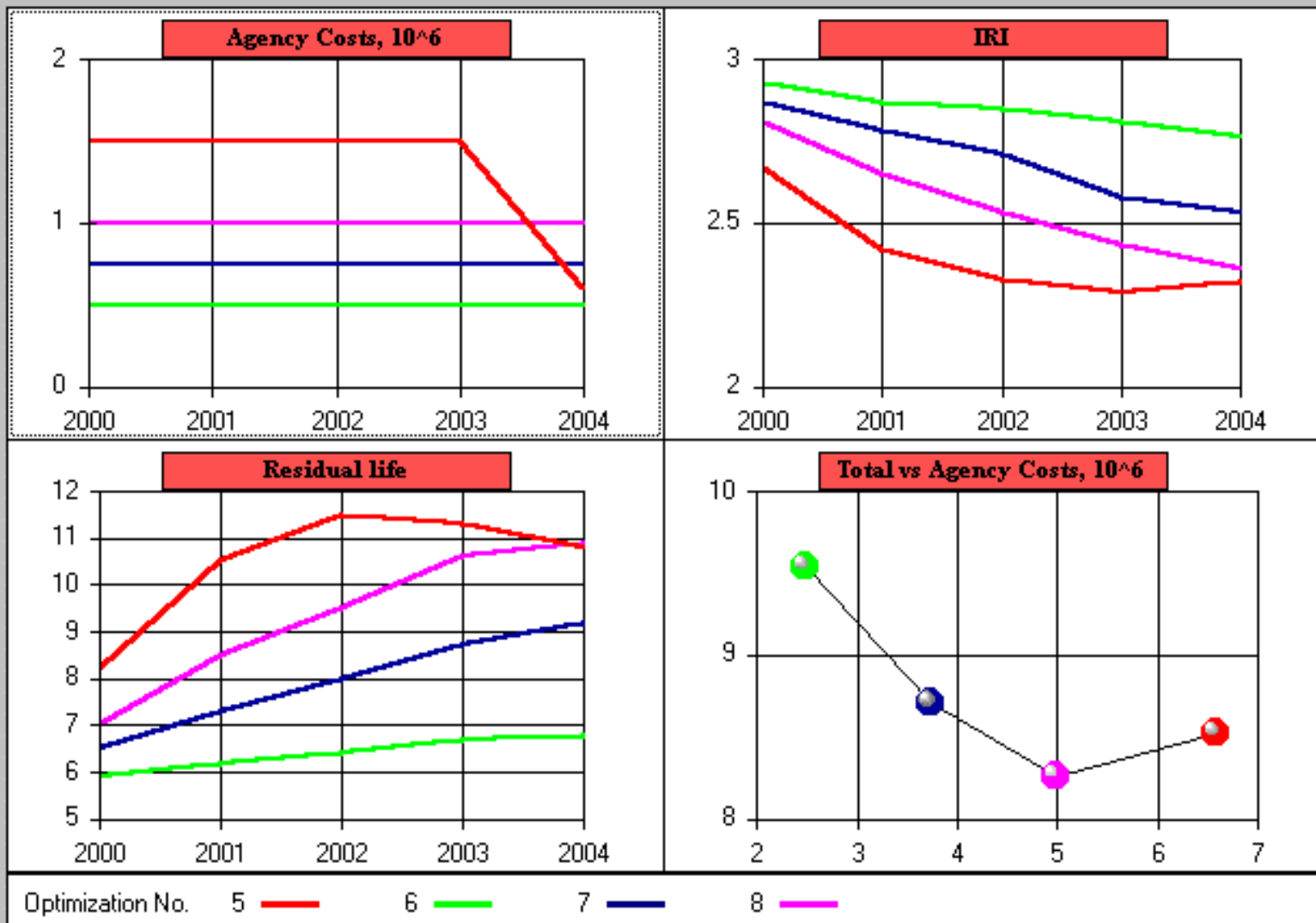


Optimization - Network Level

- Most efficient strategies are extracted from the database and evaluated
- Selects strategies with lowest overall costs subject to budget limitations (efficiency frontier).
- Must stay within budget
- Up to 25 year programming period (typically 3-5 year period used)

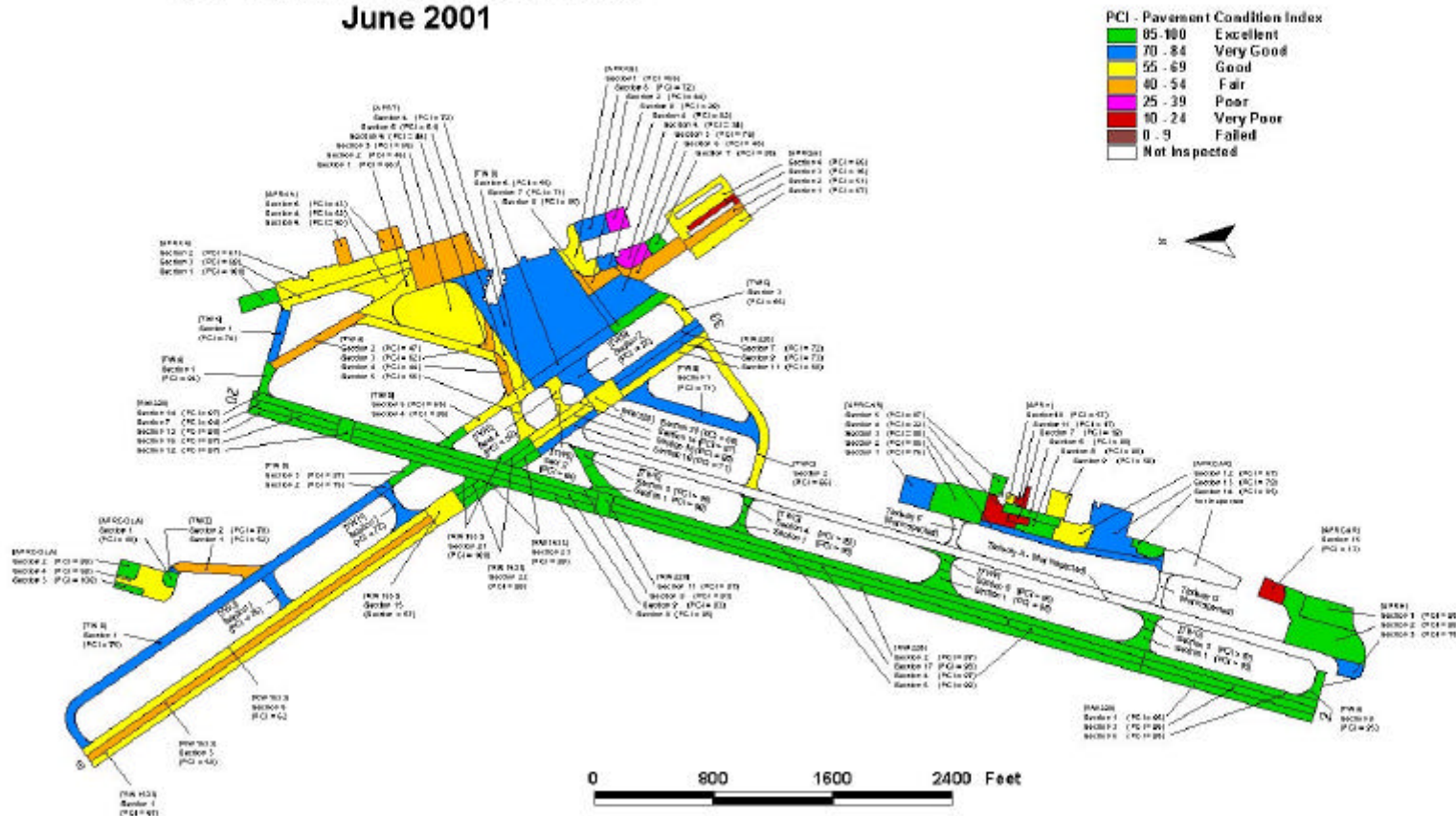
Optimization Results

Graphics Edit Tables Delete Results Close



GIS - Condition

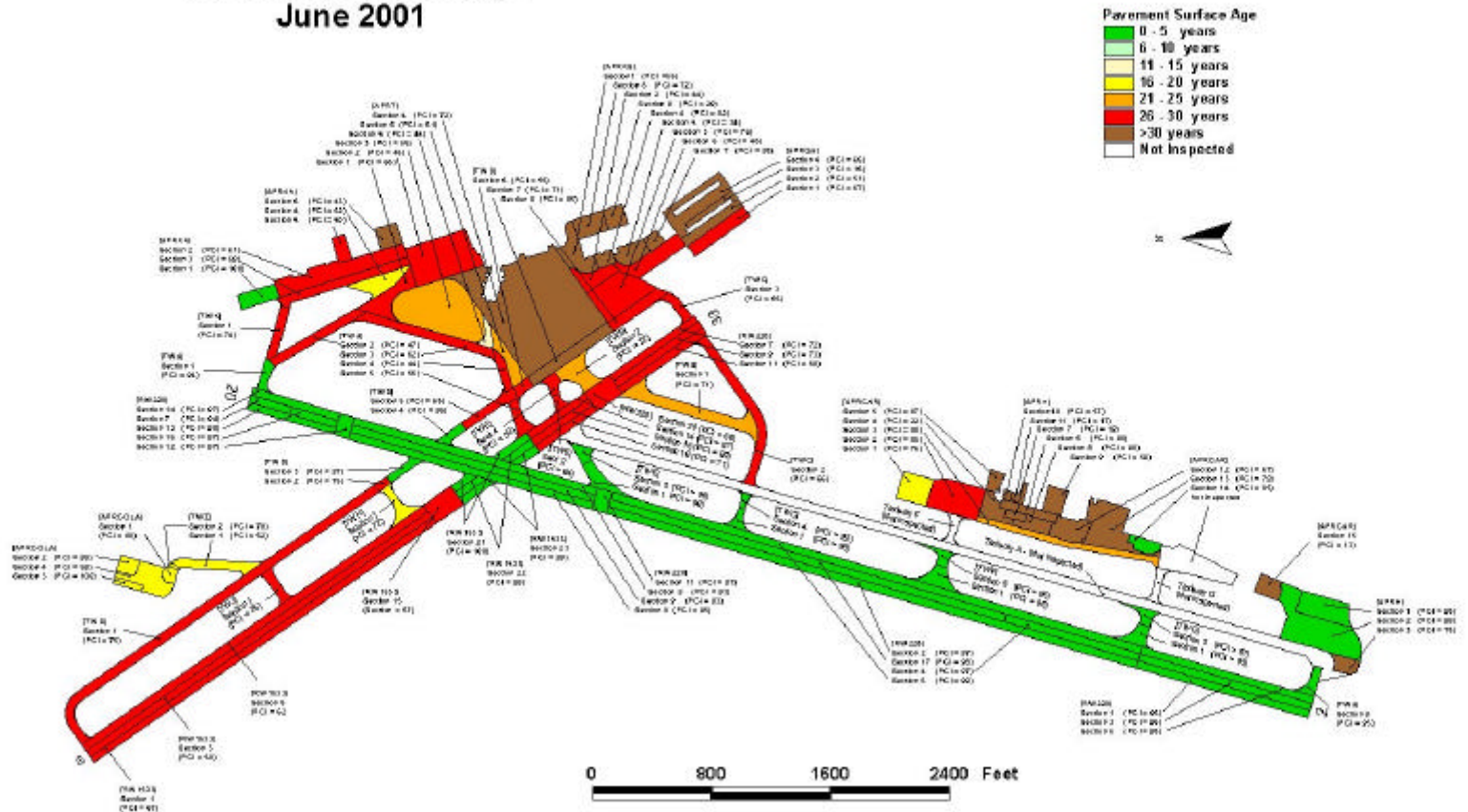
**Chattanooga Lovell Field
 PCI - Pavement Condition Index -
 June 2001**



MAP 3

GIS- Age

**Chattanooga Lovell Field
 Pavement Surface Age
 June 2001**



MAP 4



Closing Thoughts

- Structural Evaluations should be a more important part of any PMS
- We will not be able to cure a pavement problem effectively if we are not concerned with early detection of the cause
- Structural Evaluations allow a PMS to be Proactive vs. Reactive
- AIRPORTS PMS can provide the solution



Thank You

Questions?