Federal Aviation Administration

FAA PAVEAIR

FAA PAVEAIR Workshop

Unit 1

What is a Pavement Management System?

What is a Pavement Management Program?

- Defined in FAA Advisory Circular 150/5380-7B
  - Specifies the procedures to be followed to assure that proper preventative and remedial pavement maintenance is performed
- Public Law 103-305, section 107, amended Title 49, Section 47105 of the United States Code
  - To be eligible for federal funding, an airport agency must implement an effective pavement maintenance management program

Pavement Management Programs Must Include:

- Pavement Inventory
  - Location, type of pavement, dimensions, construction date
- Inspection Schedule
  - Detailed inspection must be performed at least once a year (3 years if PCI is used)
  - Less detailed inspection periodically (daily, weekly, monthly)
- Record Keeping
  - Inspection date, location, distress types, maintenance scheduled or performed
- Information Retrieval
- Program Funding

What is an Airport Pavement Management System?

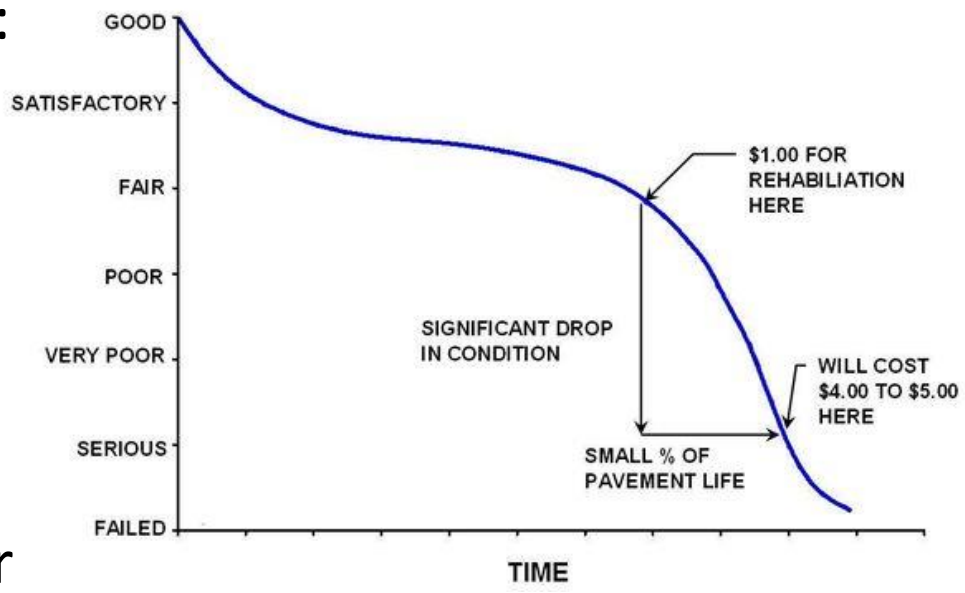
- Discussed in FAA Advisory Circular 150/5380-7B
  - A system which identifies optimum strategies to maintain pavements at an adequate level of serviceability
  - Includes systematic procedures for scheduling maintenance and rehabilitation activities
  - Optimizes benefits while minimizing cost

Benefits of an Airport Pavement Management System

Provides	Identifies
Objective and consistent evaluation of pavement conditions	Budget requirements necessary to maintain pavements at various levels of serviceability
Systematic and documentable engineering basis for determining maintenance and rehabilitation needs	Impact on the pavement network as a result of performing no major repairs
Documentation on the present and future condition of the pavements in a network	Life-cycle costs for various maintenance and rehabilitation alternatives

Pavement Life Cycle Curve

- First several years of life: low deterioration
- At a certain point in time: deterioration accelerates
- Preventive maintenance early in pavement life is more cost effective than major maintenance later in life
- Determine the optimum time to effectively apply funds



Typical Pavement Life Cycle Curve

History of FAA PAVEAIR

PAVER PMS

In 1968, CERL begins development of a mainframe PMS for the DOD. The first version is completed in 1972.

Public Law 103-305

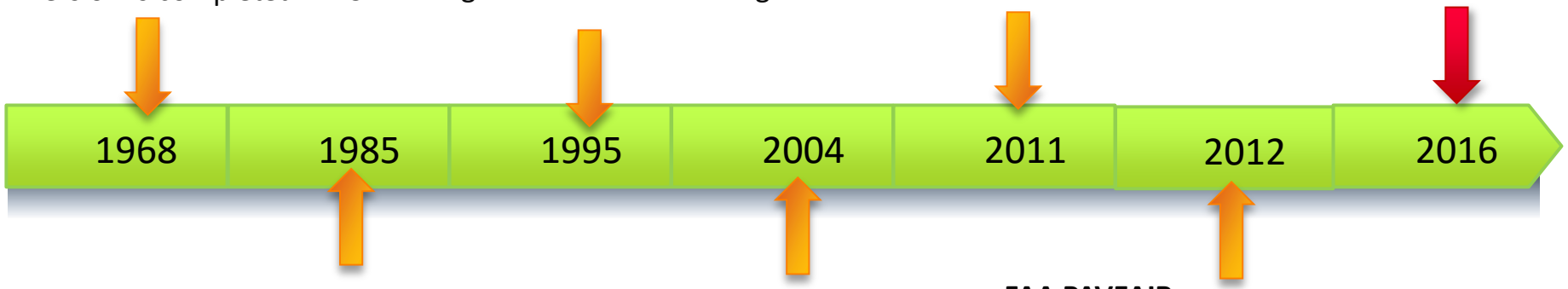
Requires an airport agency to show that it has an effective PMS in place to be eligible for federal funding.

FAA PAVEAIR

February 2011, FAA releases a beta of FAA PAVEAIR, a public web-based APMS

FAA PAVEAIR

May 2016, FAA releases FAA PAVEAIR 2.6.



MicroPAVER

In 1985, the FAA funds CERL to develop a microcomputer version of PAVER, named MicroPAVER. The first version is released in 1987.

APMS Systems in Use

By 2004, 84% of state aviation agencies in the US use an APMS.

FAA PAVEAIR

June 2012, FAA releases FAA PAVEAIR 2.0.

** CERL (U.S. Army Construction Engineering Research Laboratory)*

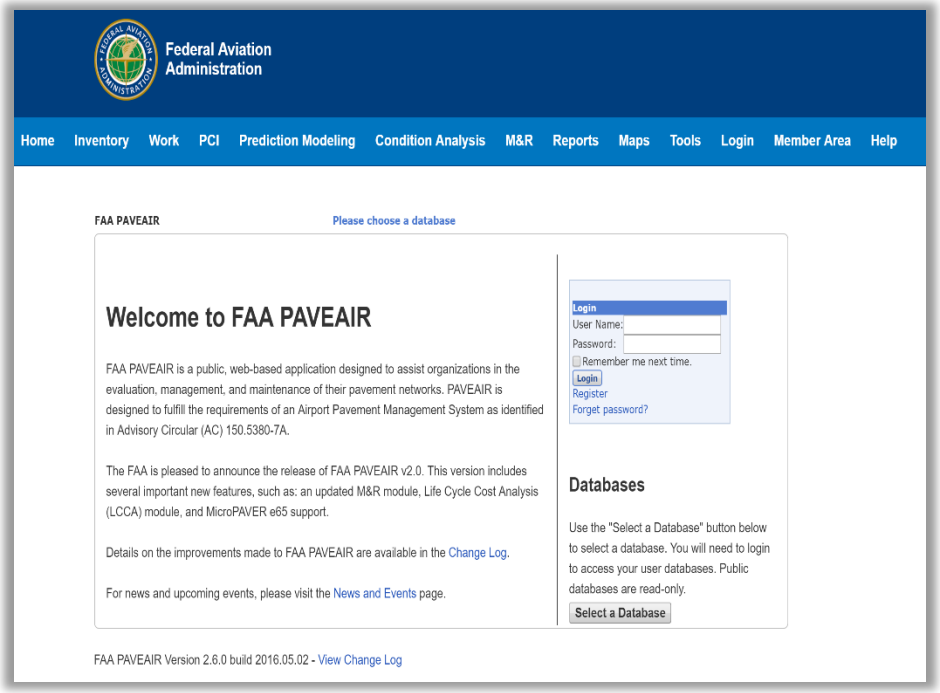
New for 2016

- Improved prediction modeling
- LCCA on server, not Excel
- Family curves integrated into M&R and Condition Analysis
- Change to comply with FAA web template
- Updated default costs
- Stored PCI values

Unit 2
FAA PAVEAIR Basics

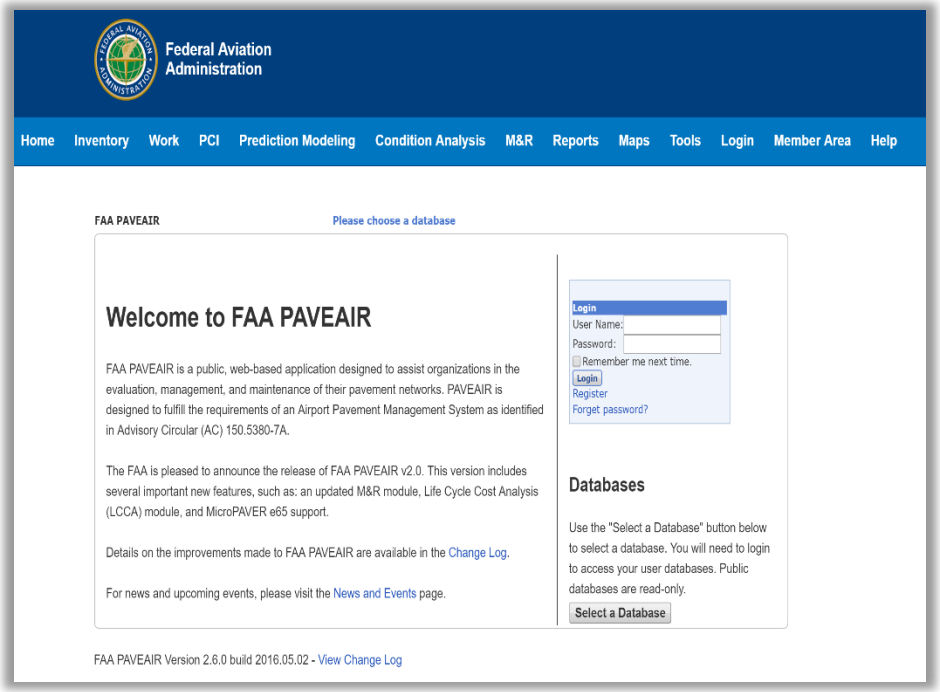
About FAA PAVEAIR

- Airport Pavement Management System
  - Publicly available and free to use (source code available)
    - Branch website
    - http://www.airporttech.tc.faa.gov
  - Data can be made “public” or “private”
  - Includes similar functionality found in MicroPAVER version 5.3
- Web-based
  - Access though the Internet, company Intranet, or a stand-alone PC
- Regional Settings
  - English / Metric



Primary Functions

- Inventory
  - Manage Pavement Inventories
- Work
  - Record Pavement Work Histories
- PCI / Update Inspections
  - Calculate PCI / SCI / FOD
  - Record Condition Surveys
- Prediction Modeling
  - Predict future pavement conditions
  - Plot PCI vs. Age
- Condition Analysis
  - Provides projections about the viability of pavements
- Maintenance and Repair Planning
- Reports / Maps
  - Generate reports
  - Mapping support with shapefiles
- Compatibility
  - Import data from MicroPAVER (e60, e65)
  - Export data to XML



Versions

- Three supported configurations
  - FAA Hosted version (http://faapaveair.faa.gov)
  - Intranet Version
  - Locally Installed version

- National Airport Pavement Test Facility
  - http://www.airporttech.tc.faa.gov
  - Additional information
  - Setup files
  - Source code

User Accounts / Databases

- Registered Users
  - Create Database
    - Multiple databases supported
    - New database or import from MicroPAVER
    - Choose to make data “Public” or “Private”
  - Manage Database
    - Delete database
    - Change between “Public” and “Private”
    - Assign permissions to other registered users

Pavement Hierarchy

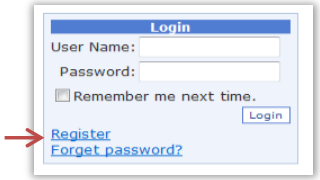
- Pavement Network
  - High-level grouping of an organization's pavements for the purposes of maintenance and repair planning
  - Examples: Ohio State University Airport, JFK Airport
- Pavement Branch
  - Identifiable area of a pavement network having a distinct function
  - Examples: Runway 9L, Taxiway D, Apron
- Pavement Section
  - Subdivision of a branch with uniform construction, maintenance, usage, condition, traffic volume, and load intensity conditions
  - Example: Section A (Runway 32 end to 3,013' west)

Create a User Account and Pavement Database

- Purpose
  - Create a user account
  - Create a new blank database
  - Set English / Metric unit preferences

Create a User Account and Pavement Database

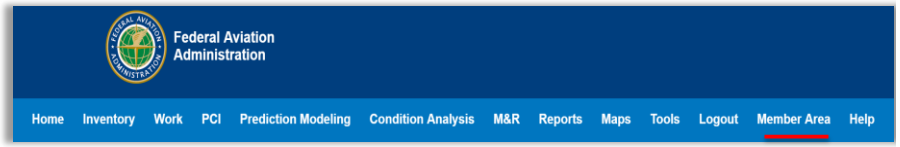
1. From the “Home” page, click on the “Register” link in the “Login” box.



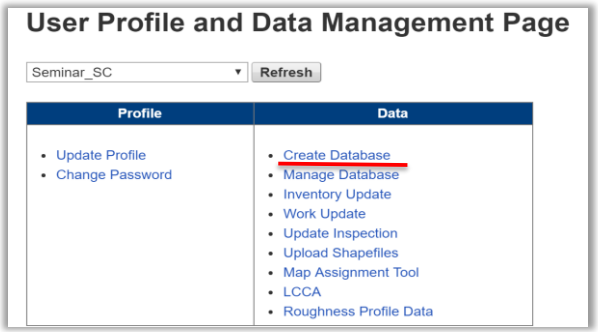
1. Fill out the “User Information” form and click “Next”.

2. Fill out the “User Name and Password” form. Here is where you will choose the username and password you will use to access the system. The “security question” and “security answer” are used in case you need to recover your password. Once completed, click the “Create User” button.

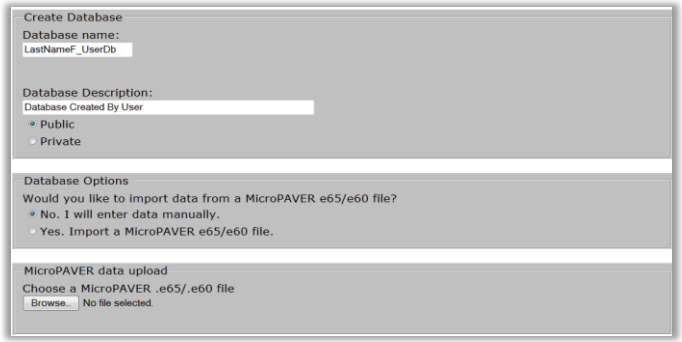
Create a User Account and Pavement Database



3. Click on the “Create Database” link.



4. Choose a name and description for your database and enter it in the form. In order to easily identify your database from the other participants’, it is recommended you use your last name and first initial followed by “_UserDB1” as your database name. For this lab, choose “Public” and select “No. I will enter data manually”, then press the “Create Database” button.

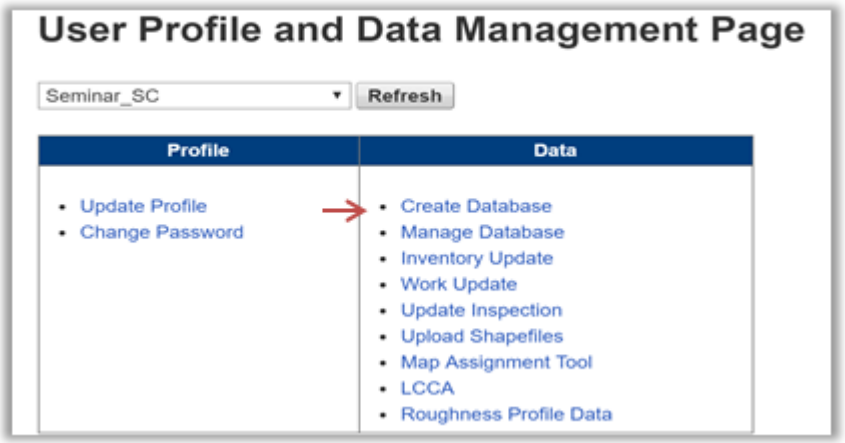


Importing MicroPAVER Data

- Importing MicroPAVER Data
  - Create an e65 file in MicroPAVER
    - Paver Database Tools
  - Create a new FAA PAVEAIR database
    - Choose to import database from a MicroPAVER e65 file

Importing MicroPAVER Data

Go to "Member Area" and Click on "Create Database" again.



Importing MicroPAVER Data

When complete, you will see the message "The database is created successfully." Click **FAA PAVEAIR Home** to select your database.

Unit 3
Assessing Pavement Condition

Pavement Condition Surveys
Inspection Process

- ASTM D 5340-12 and ASTM D 6433-10
  - Provides step-by-step process for identifying distresses, filling out survey forms, and calculating section PCI
- Create Sample Units
  - Divide pavement sections into Sample Units for Inspection
- Determine the Number of Sample Units
  - Calculate the minimum number of sample units that must be inspected
- Record Distresses
  - Condition Survey Forms
- Enter Inspection Data
  - Enter inspection data into FAA PAVEAIR's Update Inspection module

Updated ASTM Standards

ASTM D5340-12 and ASTM D6433-10 identify new distresses and their deduct curves. FAA PAVEAIR has been updated to reflect these changes.

ASTM D6433-09 - Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys

Surface Type	Old Distress	New Distress
Asphalt	19. Weathering / Raveling	19. Raveling
		20. Weathering

ASTM D5340-10 - Standard Test Method for Airport Pavement Condition Index Surveys

Surface Type	Old Distress	New Distress
Asphalt	12. Weathering / Raveling	12. Raveling
		17. Weathering

Surface Type	Old Distress	New Distress
Concrete	10. Scaling / Map Crack / Crazing	10. Scaling / Map Crack / Crazing
		16. Alkali Silica Reaction (ASR)

Types of Distresses

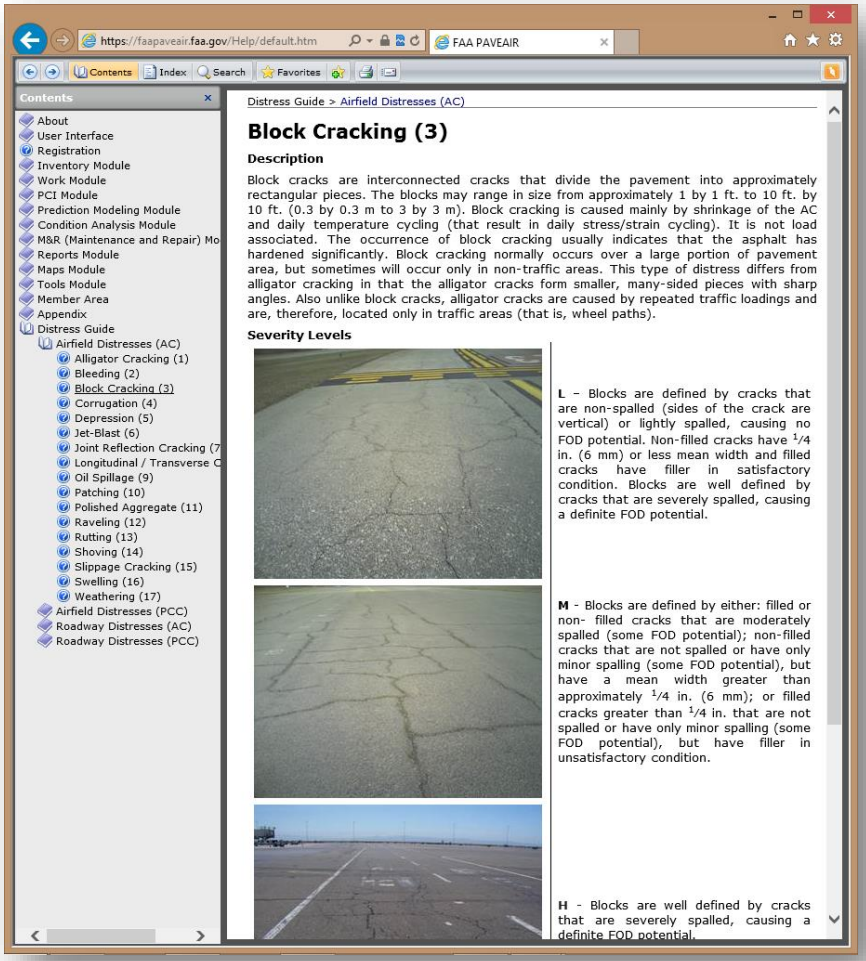
Distress Codes (AC)
1. Alligator Cracking
2. Bleeding
3. Block Cracking
4. Corrugation
5. Depression
6. Jet Blast
7. Joint Reflection (PCC)
8. Long. & Trans. Cracking
9. Oil Spillage
10 Patching
11. Polished Aggregate
12. Raveling
13. Rutting
14. Shoving from PCC
15. Slippage Cracking
16. Swell
17. Weathering

Distress Codes (PCC)
1. Blow up
2. Corner Break
3. Long / Trans / Diagonal Crack
4. Durability "D" Crack
5. Joint Seal Damage
6. Patching (Small)
7. Patching (Large) and Utility Cut
8. Popouts
9. Pumping
10. Scaling / Map Crack / Crazing
11. Settlement / Fault
12. Shattered Slab
13. Shrinkage Crack
14. Spalling-Joints
15. Spalling-Corner
16. Alkali Silica Reaction (ASR)

Rutting

Patching (Small)

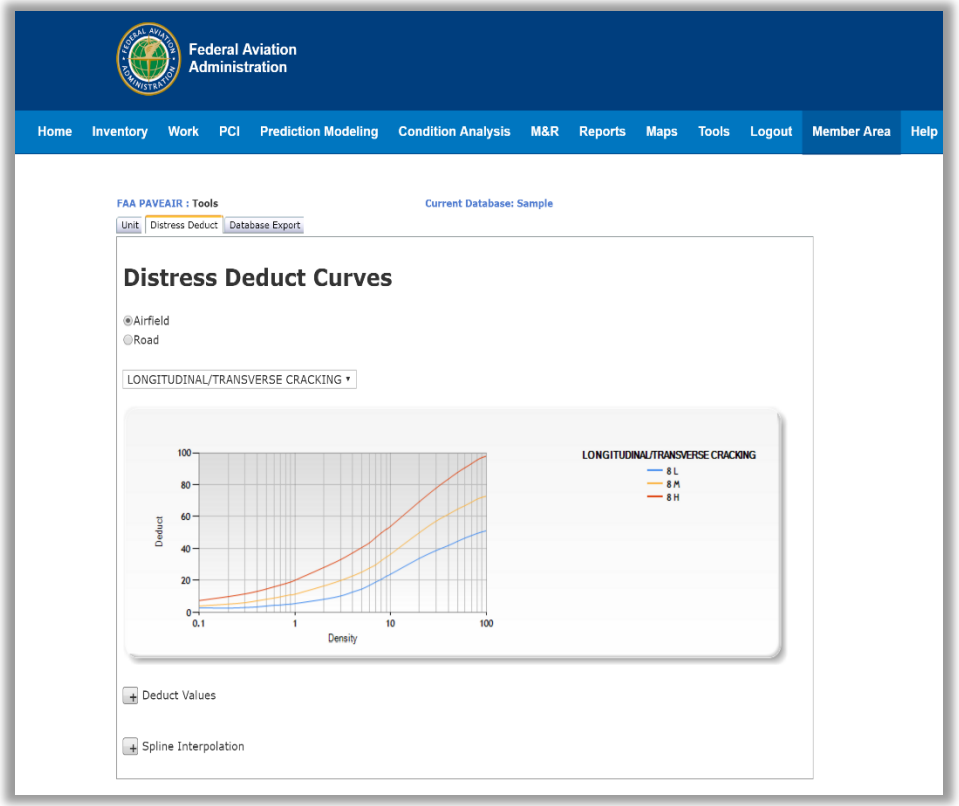
Distress Guide



- Distress Guide
  - Part of the “Help” system
  - High resolution color pictures
  - Shows distresses at high, medium, and low
  - Explains how to properly measure each distress

Distress Deduct Curves

- Distress Deduct Curves
  - View deduct curves for each distress
  - Deduct value details
  - Spine interpolation equation



Create Sample Units

- Divide pavement sections into sample units for inspection
  - Asphalt
    - Subdivide into sample units consisting of 464.5 m^2 (5,000 ft^2)of contiguous area (± 186 m^2)
  - Concrete
    - Subdivide into sample units consisting of 20 contiguous slabs (± 8 slabs)

Determine Number of Sample Units

- Total Sampling
  - Total sampling is desirable for project analysis
  - May not be feasible for routing management due to manpower, funds, and time required
- Partial Sampling
  - Calculate the minimum number of random sample units *n* that must be surveyed to obtain a 95% confidence level

$$n = \frac{Ns^2}{\left(\left(\frac{e^2}{4}\right)(N-1) + s^2\right)}$$

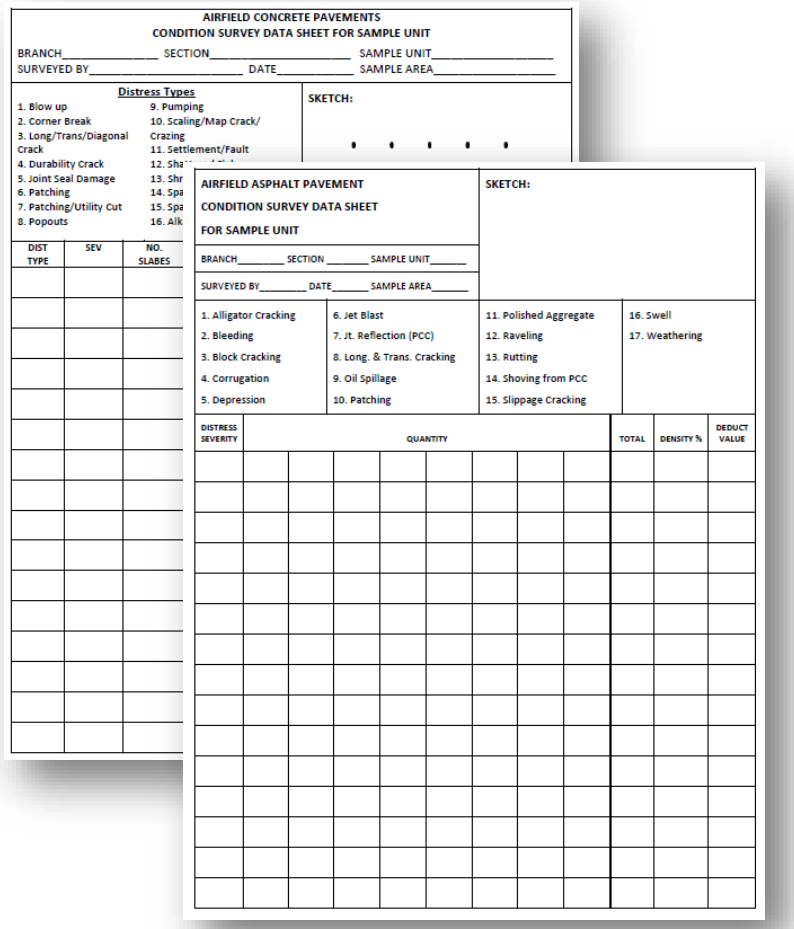
e = acceptable error in estimating the section PCI; ± 5 PCI points

s = standard deviation of the PCI from one sample unit to another; assumed to be 10 for AC pavements and 15 for PCC pavements

N = total number of sample units in the section

Record Distresses

- Record distresses using the procedures documented in ASTM D5340-10 and ASTM D 6433-09
  - Divide pavements into sample units
  - Perform condition survey of sample units
  - Record distresses, severity, and quantity on survey data sheets
- Print survey data sheets from FAA PAVEAIR's Update Inspections Module
  - Distresses for Asphalt Pavements
  - Distresses for Concrete Pavements



AIRFIELD CONCRETE PAVEMENTS
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

BRANCH_____ SECTION_____ SAMPLE UNIT_____
SURVEYED BY_____ DATE_____ SAMPLE AREA_____

Distress Types

1. Blow up
2. Corner Break
3. Long/Trans/Diagonal Crack
4. Durability Crack
5. Joint Seal Damage
6. Patching
7. Patching/Utility Cut
8. Popouts
9. Pumping
10. Scaling/Map Crack/ Crazing
11. Settlement/Fault

SKETCH:

DIST TYPE	SEV	NO. SLABES

AIRFIELD ASPHALT PAVEMENT
CONDITION SURVEY DATA SHEET
FOR SAMPLE UNIT

BRANCH_____ SECTION _____ SAMPLE UNIT_____
SURVEYED BY_____ DATE_____ SAMPLE AREA_____

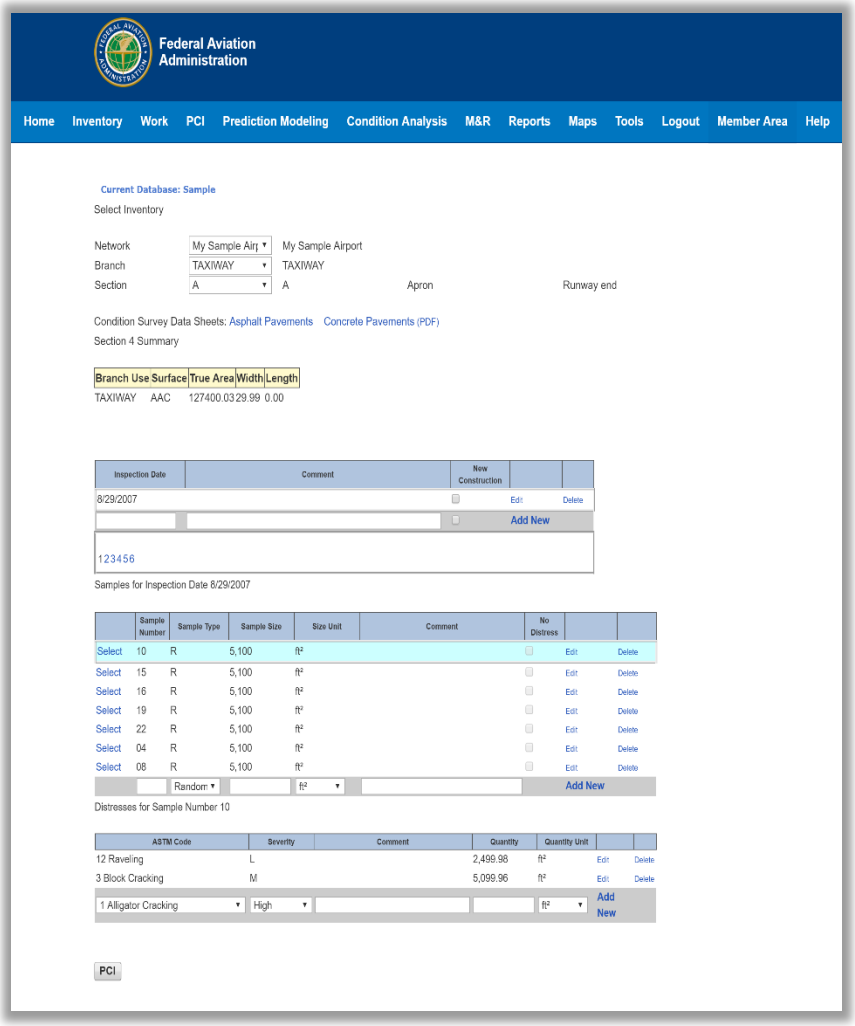
SKETCH:

1. Alligator Cracking
2. Bleeding
3. Block Cracking
4. Corrugation
5. Depression
6. Jet Blast
7. Jt. Reflection (PCC)
8. Long. & Trans. Cracking
9. Oil Spillage
10. Patching
11. Polished Aggregate
12. Raveling
13. Rutting
14. Shoving from PCC
15. Slippage Cracking
16. Swell
17. Weathering

DISTRESS SEVERITY	QUANTITY									TOTAL	DENSITY %	DEDUCT VALUE

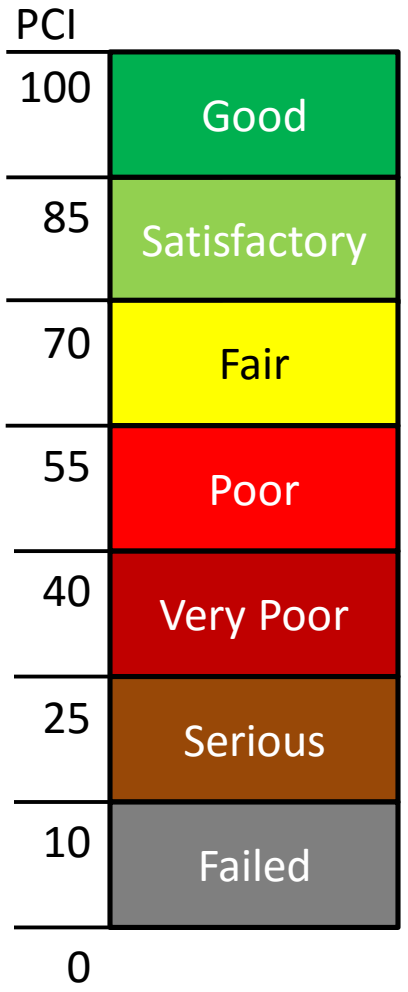
Enter Inspection Data
Update Inspection

- Input / update inspection data from Condition Surveys
- PCI button
  - Calculates section condition (PCI)
  - Displays distress, deduct, and PCI details



Pavement Condition Index (PCI)

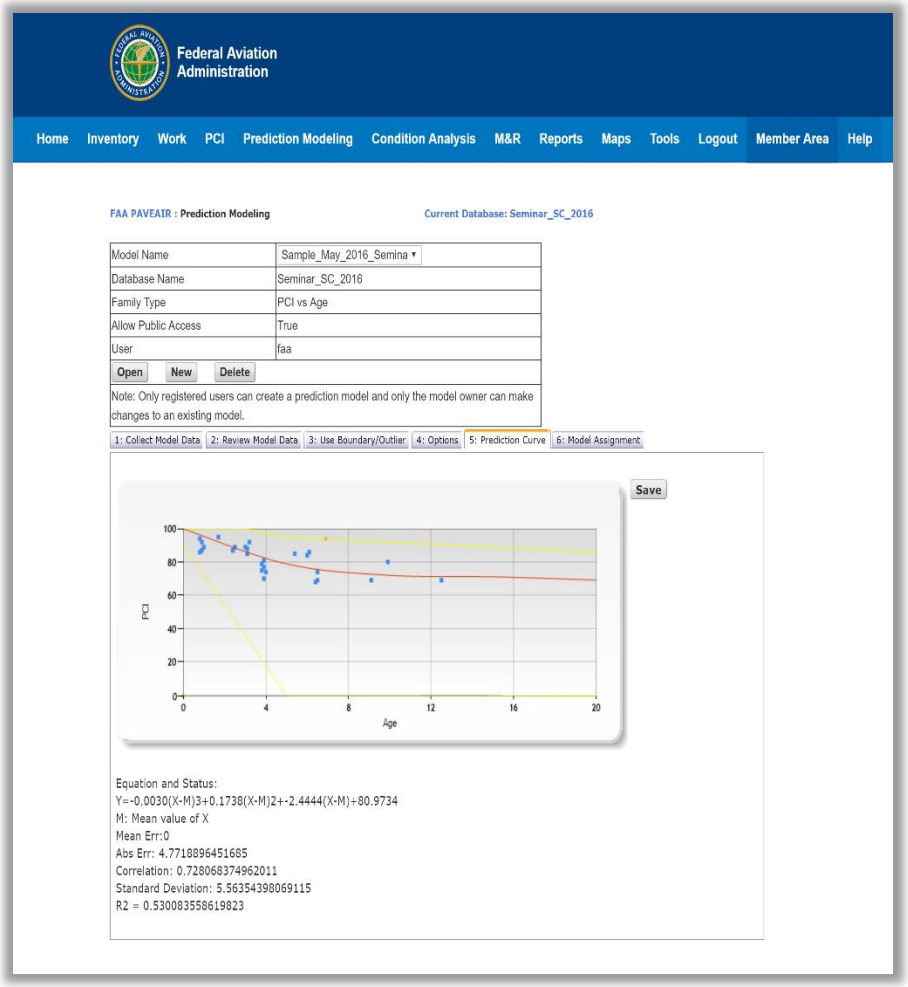
- FAA PAVEAIR uses the procedures documented in ASTM D5340 to calculate PCI
- Developed by the US Army Corps of Engineers
- Quantify Airport Pavement Condition
- Numerical rating of the pavement condition



Unit 4
Predicting Pavement Performance

Prediction Modeling

- Collect Model Data
  - Group pavement sections of similar construction and with similar traffic patterns
- Review Model Data
- Use Boundary / Outlier
  - Filter out erroneous data points
- Options
- Prediction Curve
  - Plot predicted PCI vs. Age

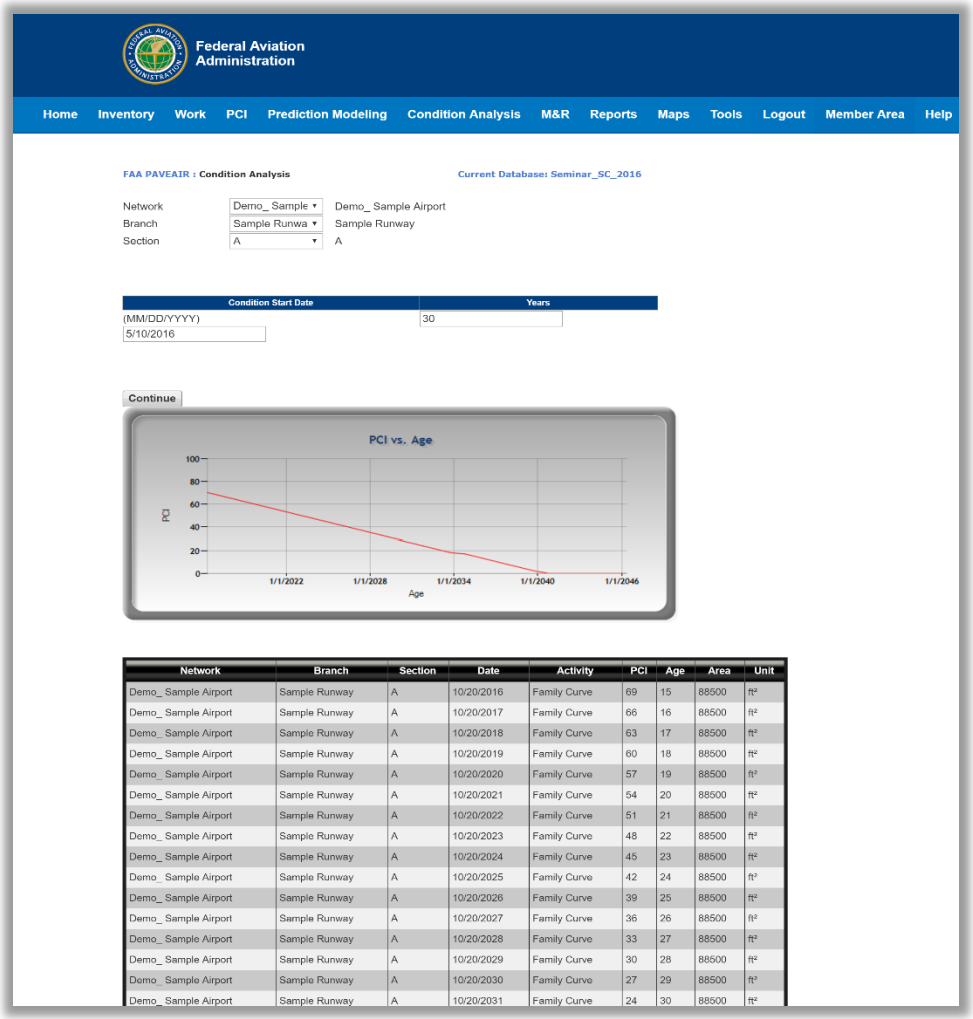


Definitions from Research

- Serviceability: Comparison of pavement's actual behavior and performance to an expectation
  - Does this pavement do what we want?
  - Not an inherent property since it is a comparison
- Distress: A condition or property that reduces serviceability
- Performance: Change in serviceability with time
- Failed: No longer meets expectations
- Condition: A quantification of serviceability to enable repeatable assessment and comparison of pavement

Condition Analysis

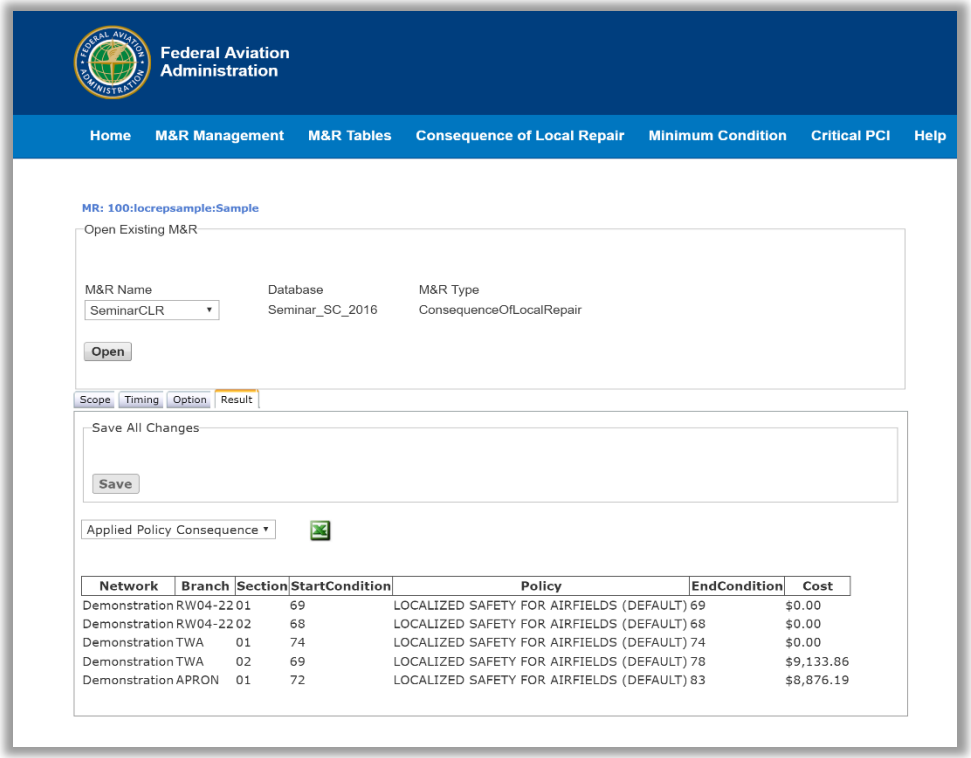
- Provides projections about the viability of pavements
- Analysis based upon:
  - Prior inspection data
  - Comparison of values between previous inspections
  - Projected conditions
- Graph PCI vs. Age



Unit 5
Maintenance and Repair Planning

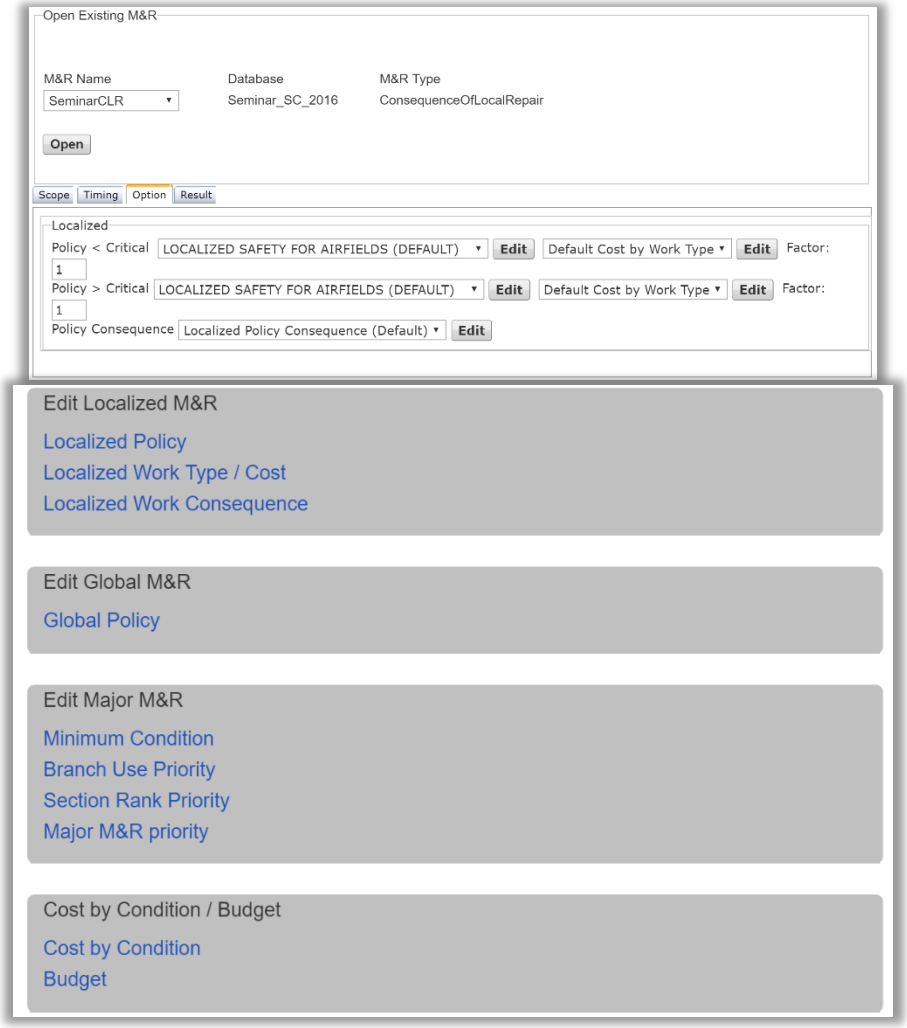
Maintenance and Repair Planning

- Scope
- Timing
- Plan Mode
  - Critical PCI Method
  - Minimum Condition
  - Consequence of Local Repair
- Policies
  - Apply Inflation Rate
  - Apply Policy in First Year
  - Global
- M&R Data
  - Applied Policy Consequence
  - Applied Policy Details
  - Inventory Info



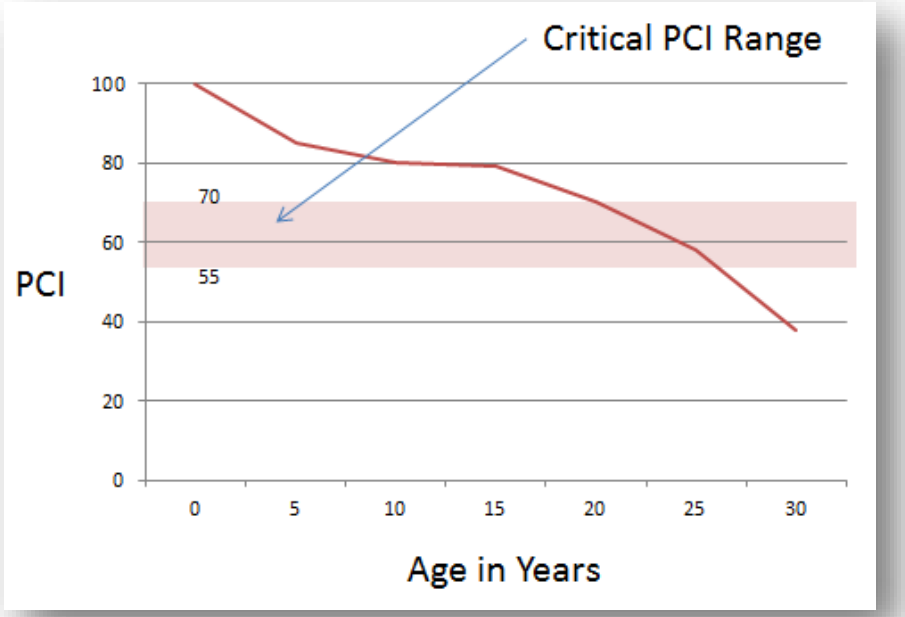
Customizable M&R Settings

- Localized M&R
  - Policy
  - Work Type / Cost
  - Work Consequence
- Global M&R
  - Policy
- Major M&R
  - Minimum Condition
  - Branch Use Priority
  - Section Rank Priority
  - Major M&R Priority
- Cost by Condition
  - Cost by Condition
  - Budget



Critical PCI Method

- Critical PCI
  - PCI value after which a pavement rapidly deteriorates
  - Usually between a PCI number of 70 and 55
- More economical to maintain pavements above rather than below the Critical PCI
  - The cost of applying localized preventive maintenance increases significantly



Minimum Condition

- Minimum Condition
  - Only concerned with the Major M&R required to maintain a minimum PCI
    - Major M&R: Any overlay or other major work that results in a PCI of 100
  - Select the lowest pavement condition that is allowed for each pavement rank
  - Prioritize the Maintenance and Repair plan to reflect the choice of “Minimum Condition” as the variable for decision making in regard to future work

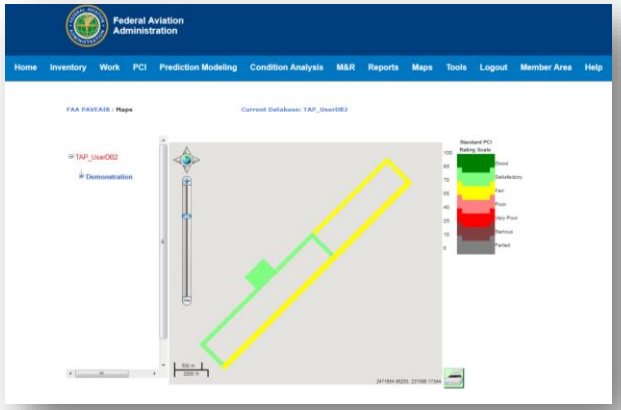
Consequence of Local Repair

- Consequence of Local Repair
  - Calculates the cost and resulting condition from the immediate implementation of local maintenance and repair.
  - M&R actions are based on current distresses and their severity.
  - Consider this plan mode for pavements above Critical PCI.

Unit 6
Additional Functions

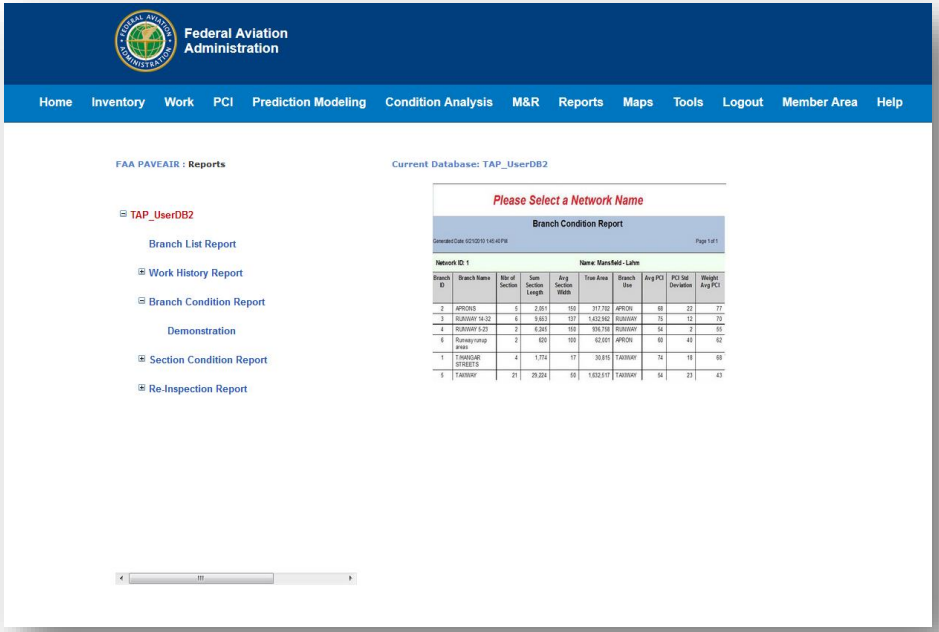
Mapping

- Add a shape file to the current database
  - Use the “Upload Shapefiles to Current DB” tool
- Import a shape file from MicroPAVER
  - Shapefiles are imported with MicroPAVER data
- Shape file assignment tool
  - Allows the assignment of pavement sections to shape file objects
  - Non-concurrent sections are supported



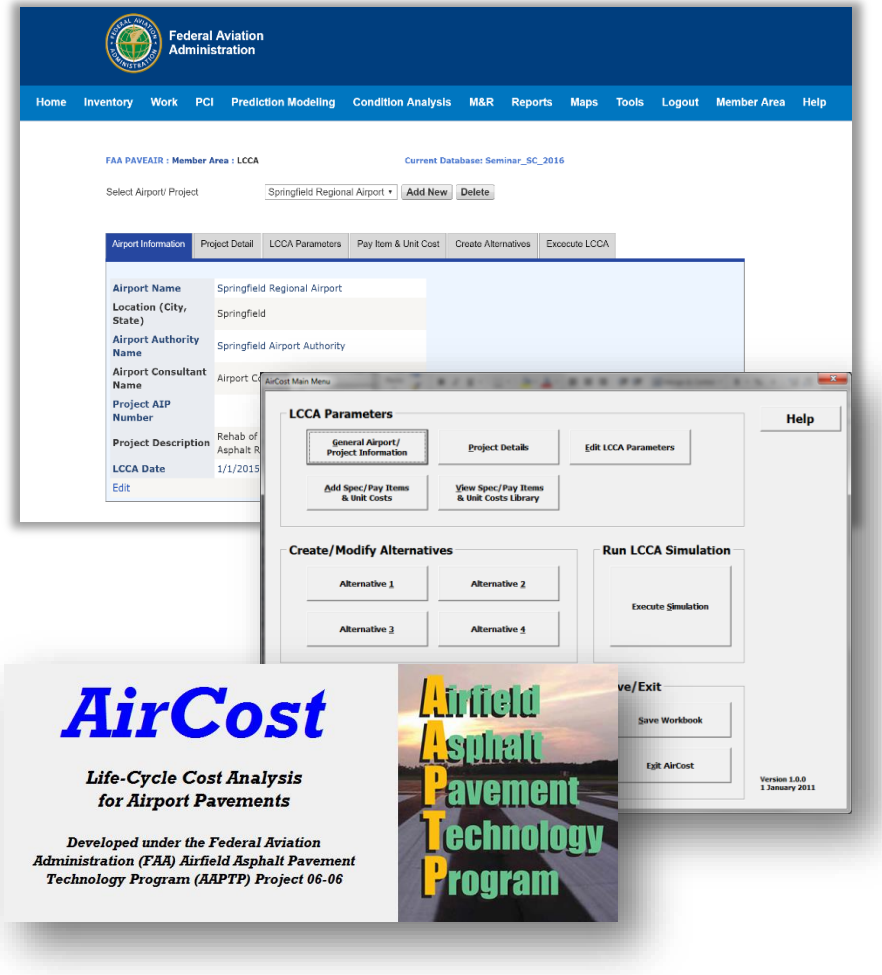
Reporting

- Available Reports
  - Branch Listing Report
  - Work History Report
  - Branch Condition Report
  - Section Condition Report
  - Re-Inspection Report
- View, print, or export in Adobe PDF or Microsoft Excel format
- Condition Reports support additional mapping features



Life Cycle Cost Analysis

- Shares data with the AAPTP AirCost LCCA application
- Economic Analysis
  - Evaluate the long-term economic efficiency between different pavement design strategies
- Procedures
  - Establish alternative pavement design strategies
  - Determine the performance period and activity timing
  - Estimate costs
  - Compute Net Present Value (NPV)
  - Analyze results
  - Re-evaluate pavement design strategies



Life Cycle Cost Analysis

- Purpose
  - To demonstrate how to work with LCCA plans
  - Show how FAA PAVEAIR links with the AirCost application

Life Cycle Cost Analysis

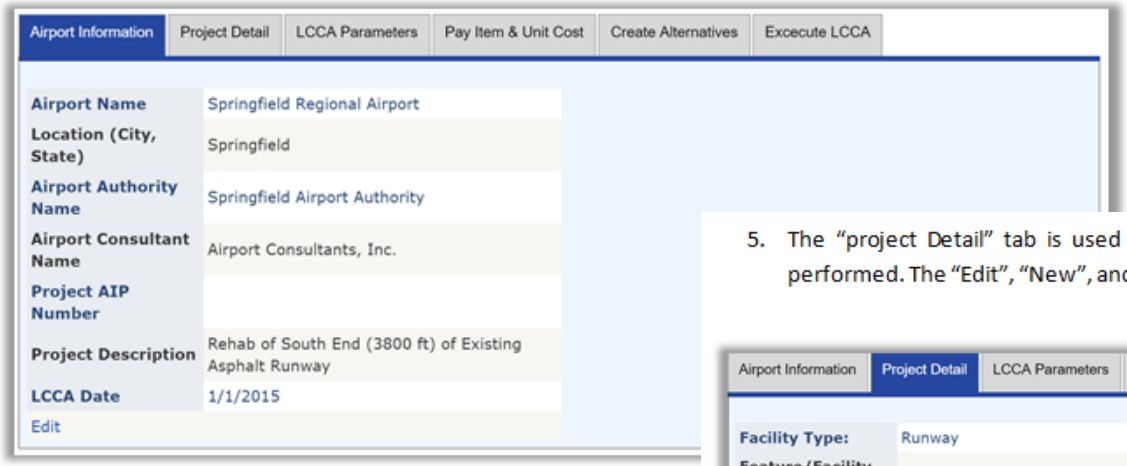
1. Select "Member Area" from the Navigation Bar.

2. From the Member Area, click the LCCA link.

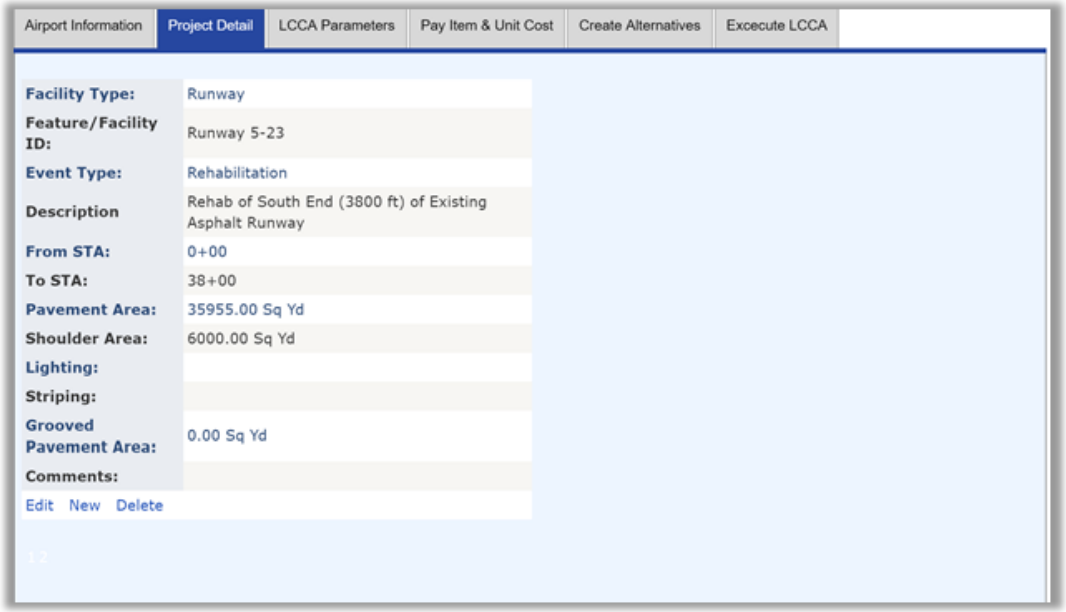
3. The "Add New" and "Delete" buttons are used to create and delete your LCCA projects. For this demonstration we will use the "Springfield Regional Airport" sample LCCA plan included with FAA PAVEAIR. From the Select Airport/ Project dropdown box, select "Springfield Regional Airport".

Life Cycle Cost Analysis

4. The "Airport Information" tab displays general information about your airport. The "Edit" link is used to update this information.

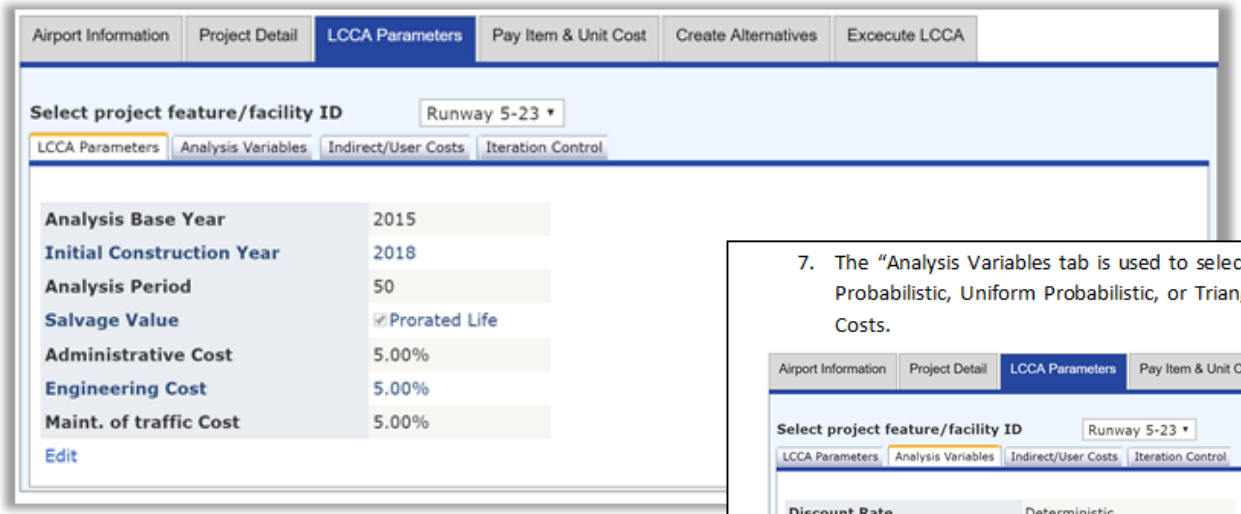


5. The "project Detail" tab is used to record the details regarding the category of work to be performed. The "Edit", "New", and "Delete" links are used to manage your Project Details.

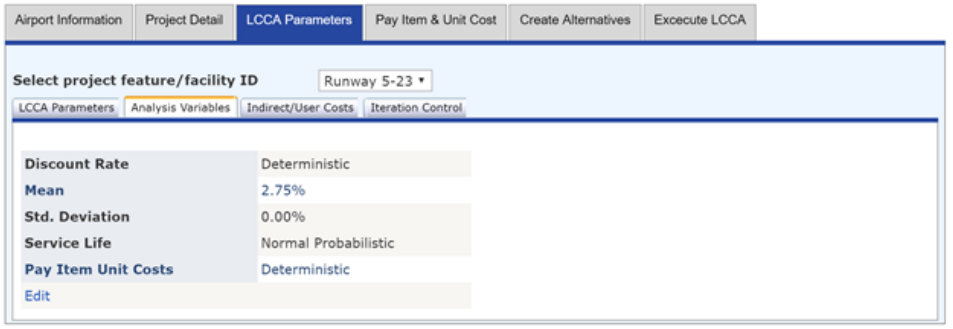


Life Cycle Cost Analysis

6. The LCCA Parameters tab is used to modify the LCCA input parameters used for the simulation. Use the "Select project feature/ facility ID" dropdown list to select our "Runway 5/23" project.



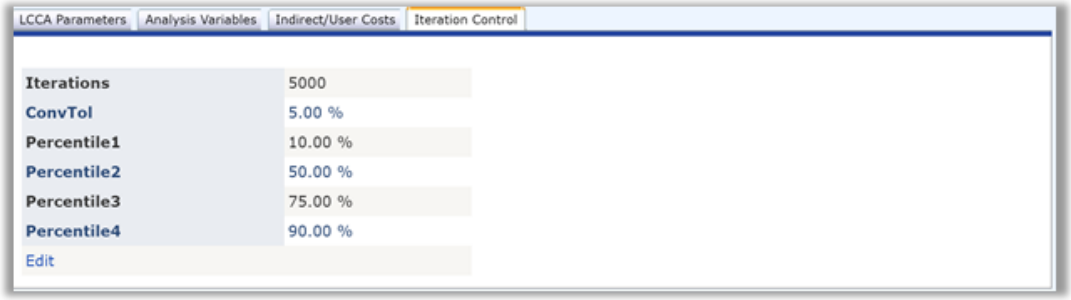
7. The "Analysis Variables tab is used to select the type of Discount Rate (Deterministic, Normal Probabilistic, Uniform Probabilistic, or Triangular Probabilistic), Service Life, and Pay Item Unit Costs.



Analysis Variables	Description
Discount Rate	Annually updated 30-year discount rate from OMB Circular A-95A.
Service Life	The service life should be based on experience.
Pay Item Unit Costs	Should be based on products purchased and used in the same geographic region.

Life Cycle Cost Analysis

9. The "Iteration Control" tab is used to control the accuracy and running time of the analysis, as well as which results to report.



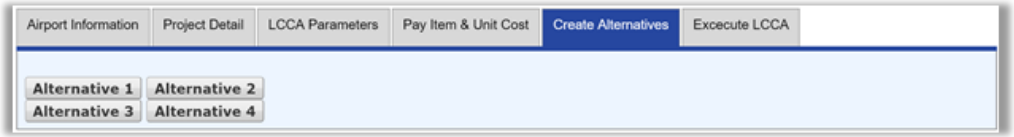
Indirect/ User Costs	Description
Iterations	Maximum number of repetitions in the simulation
ConvTol	How precise must the results be? Lower numbers indicate higher precision and require longer run times
Percentile1	Percentile of first reported result. The cost for which *Percentile1* percent of the simulations were lower.
Percentile2	Percentile of first reported result. The cost for which *Percentile2* percent of the simulations were less expensive.
Percentile3	Percentile of first reported result. The cost for which *Percentile3* percent of the simulations were less expensive.
Percentile4	Percentile of first reported result. The cost for which *Percentile4* percent of the simulations were less expensive.

Life Cycle Cost Analysis

10. The "Pay Item Cost" tab is used to manage the material library for inclusion in events and alternatives.

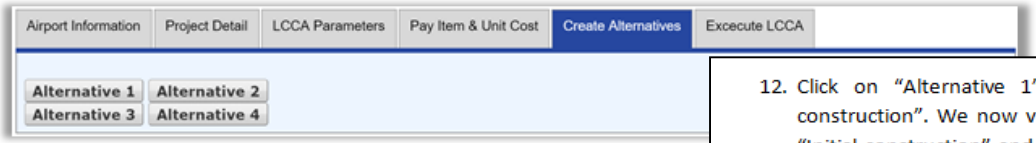
Edit-Update	ID	Spec/Pay Item Name	Spec/Pay Item No	Classification	Unit	Mean Unit cost	Std Dev Unit Cost	Delete
Edit	1	Common Excavation	P-100-4	Base/ Subbase	cu yd	7.42	1.94	Delete
Edit	2	Topsoil Borrow (LV)	P-100-5	Base/ Subbase	cu yd	25.67	4.04	Delete
Edit	3	Aggregate Base Class 5 (CV)	P-100-7	Base/ Subbase	cu yd	19.67	2.89	Delete
Edit	4	Subbase Course	P-154-A	Base/ Subbase	cu yd	0.00	0.00	Delete
Edit	5	Aggregate Base Course-Uncrushed	P-208-A	Base/ Subbase	cu yd	0.00	0.00	Delete
Edit	6	Aggregate Base Course-Crushed	P-208-B	Base/ Subbase	cu yd	0.00	0.00	Delete
Edit	7	Crushed Aggregate Base Course (6-in depth)	P-209-A1	Base/ Subbase	sq. yd	6.50	1.30	Delete
Edit	8	Crushed Aggregate Base Course (8-in depth)	P-209-A2	Base/ Subbase	sq. yd	8.00	1.60	Delete
Edit	9	Crushed Aggregate Base Course (10-in depth)	P-209-A3	Base/ Subbase	sq. yd	9.50	1.90	Delete
Edit	10	Crushed Aggregate Base Course (12-in depth)	P-209-A4	Base/ Subbase	sq. yd	11.00	2.20	Delete
Edit	11	Crushed Aggregate Base Course (cu yd)	P-209-B	Base/ Subbase	cu yd	25.00	5.00	Delete
Edit	12	Crushed Aggregate Base Course (ton)	P-209-C	Base/ Subbase	ton	14.00	2.80	Delete
Edit	13	Concrete Pavement Rubblization	P-215-A	Base/ Subbase	sq. yd	2.50	0.50	Delete
Edit	14	Recycled Concrete Aggregate Base Course (6-in depth)	P-219-A1	Base/ Subbase	sq. yd	2.75	0.55	Delete
Edit	15	Recycled Concrete Aggregate Base Course	P-219-A1	Base/ Subbase	ton	6.00	1.20	Delete

11. The "Create Alternatives" tab allows you to create up to four different scenarios for analysis.

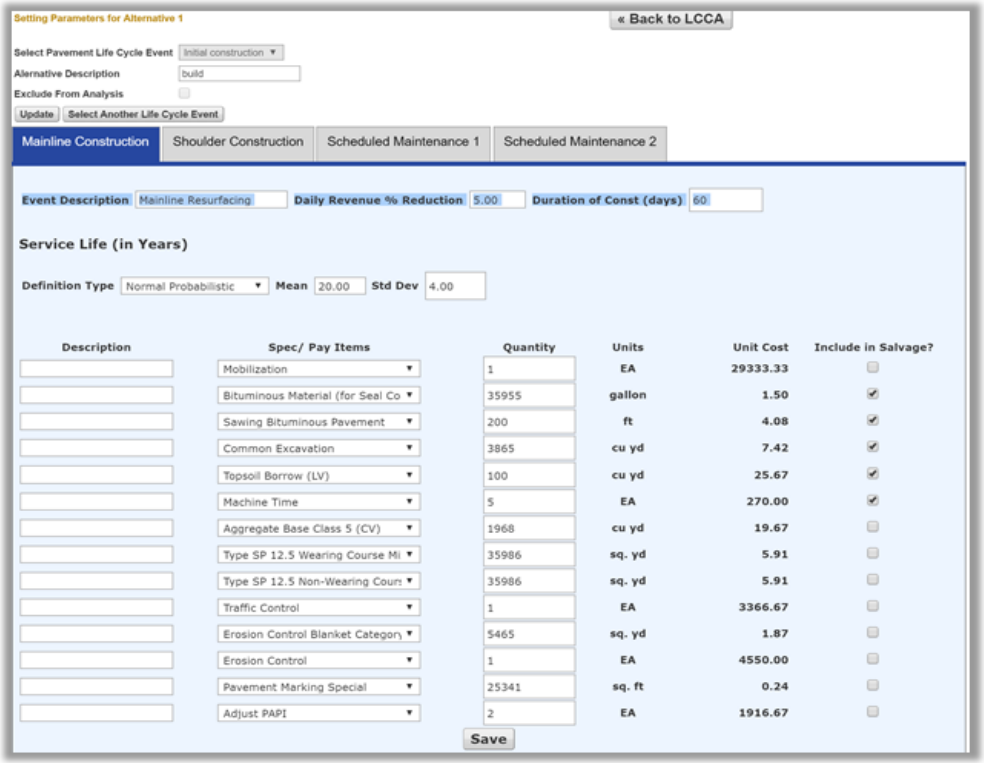


Life Cycle Cost Analysis

11. The "Create Alternatives" tab allows you to create up to four different scenarios for analysis.

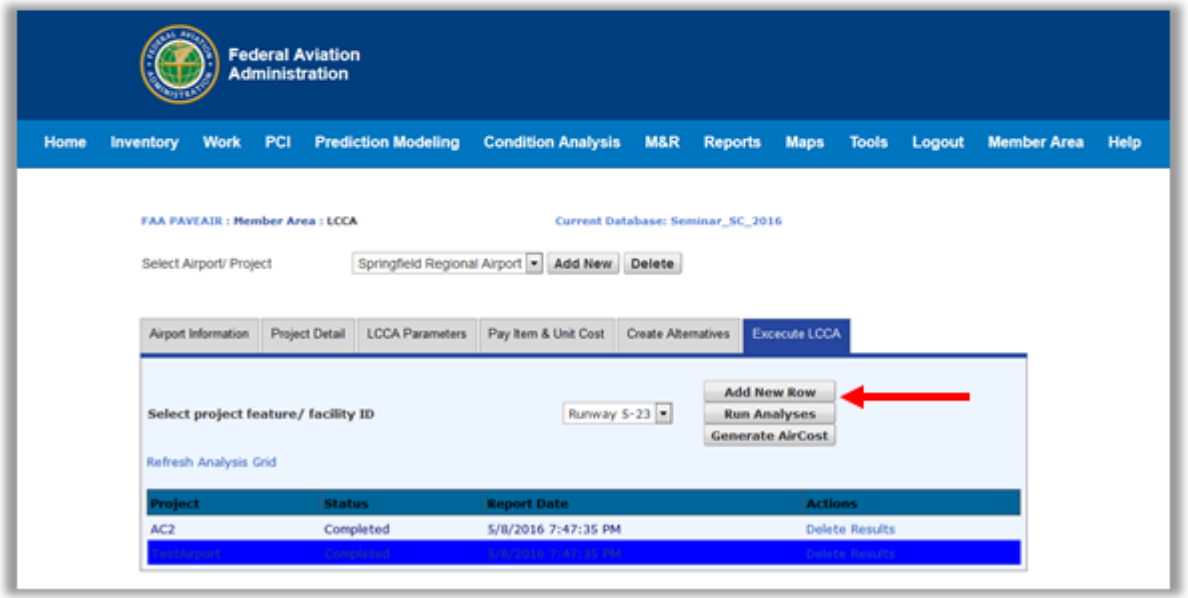


12. Click on "Alternative 1". From the dropdown box select the Life-Cycle Event: "Initial construction". We now view and edit the specifics for the plan. For this demonstration, the "Initial construction" and "Rehab 1" events have been pre-defined. Click the "Back to LCCA" button.



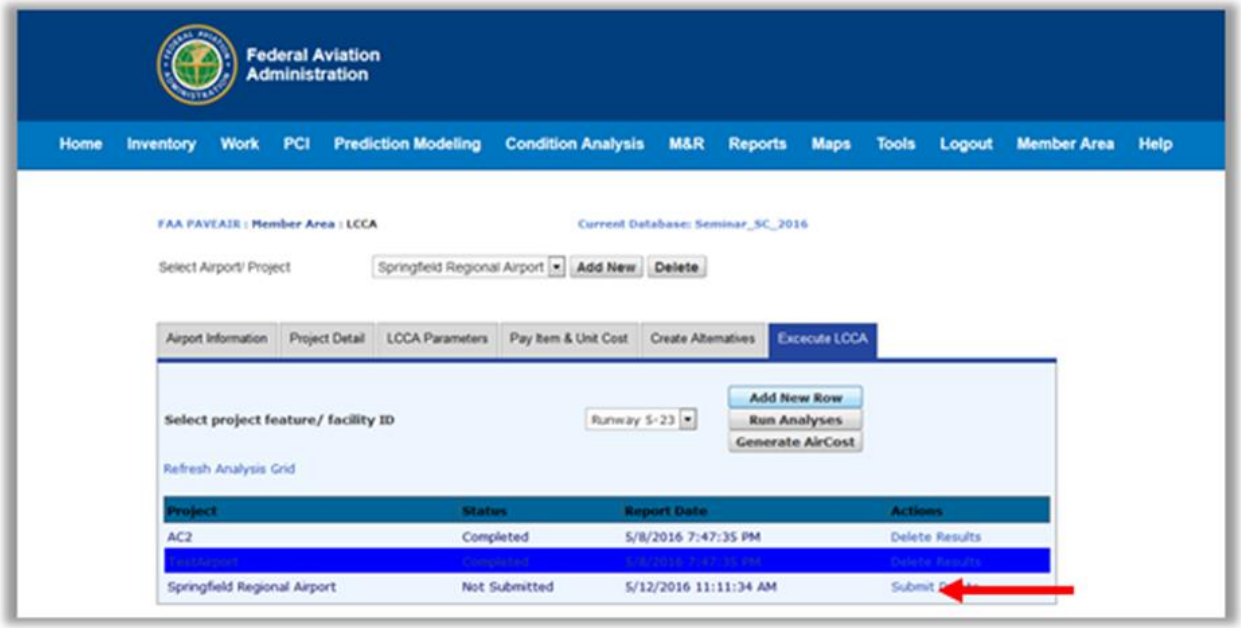
Life Cycle Cost Analysis

13. A queueing system is used to manage analysis runs. This allows users to set up multiple analysis and have them run in the background. Analyses are listed in the analysis grid. The status of each analysis is shown. "Not Submitted" indicates that the analysis has not been finalized and submitted to the analysis module. "Queued" indicates the analysis has been finalized and submitted, but results have not be calculated. "In Progress" indicates the results of that analysis are currently being calculated. "Complete" indicates the results are ready for viewing. To queue an analysis, select it from the "Select project feature/facility ID" drop down and press "Add New Row". A new row is added to the analysis grid.



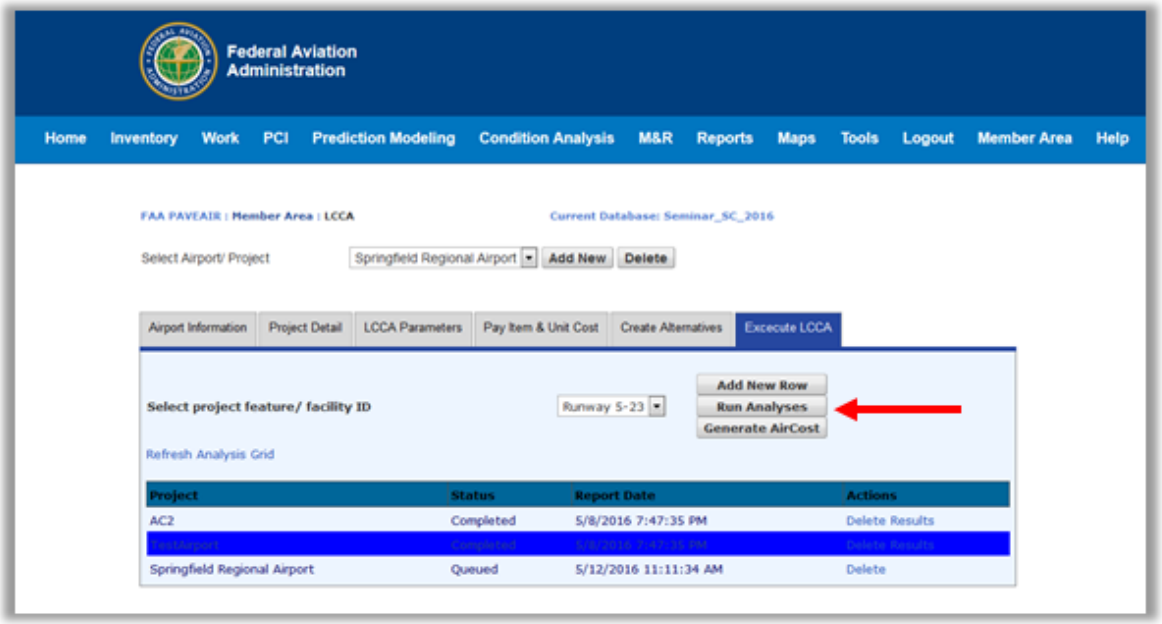
Life Cycle Cost Analysis

14. Click the "Submit" button to submit the parameters to the analysis engine. Any changes made in the analysis parameters made after clicking "submit" will not be reflected in the results.



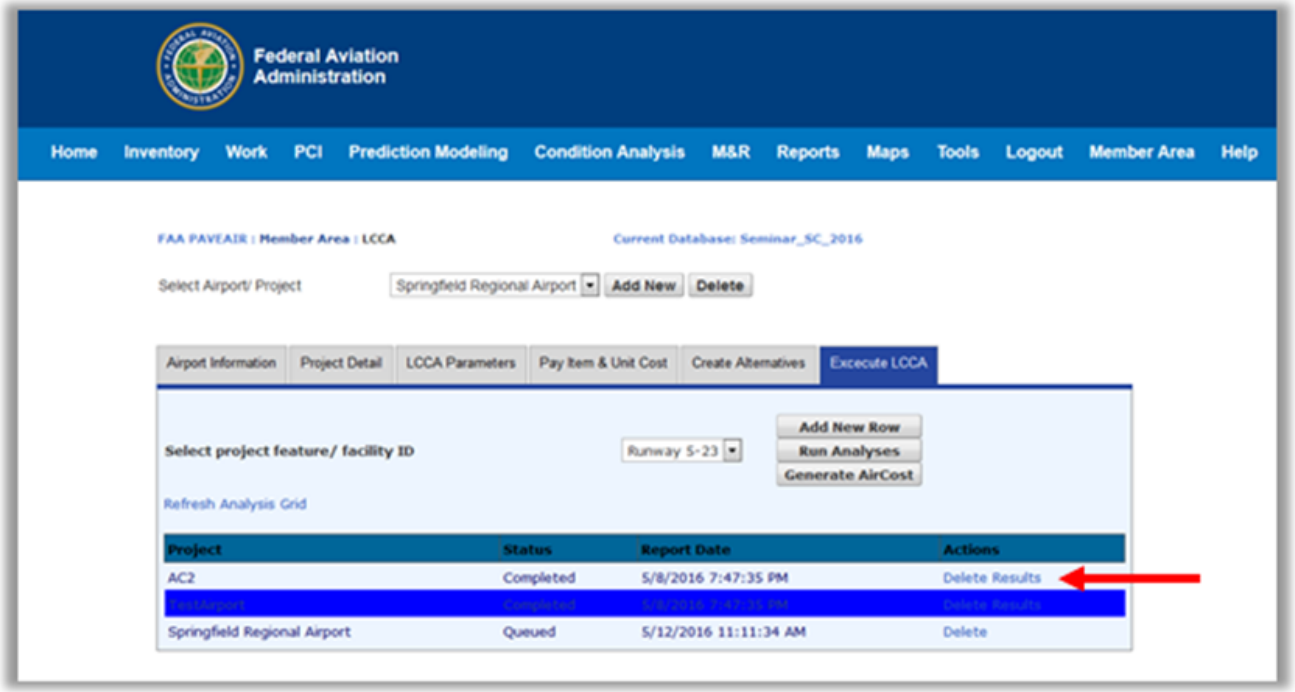
Life Cycle Cost Analysis

15. Click the "Run Analyses" to start the analysis engine. Results will be calculated for all analyses with the status of "Queued".



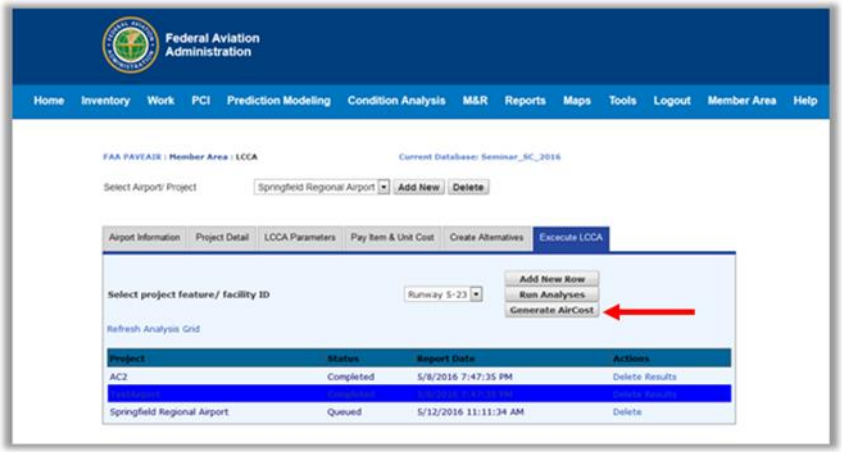
Life Cycle Cost Analysis

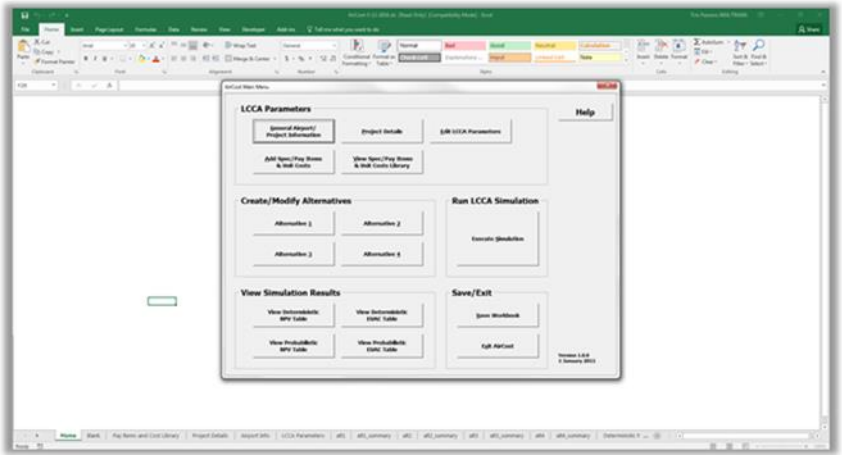
16. Click "Results" to see the results of the analysis.



Life Cycle Cost Analysis

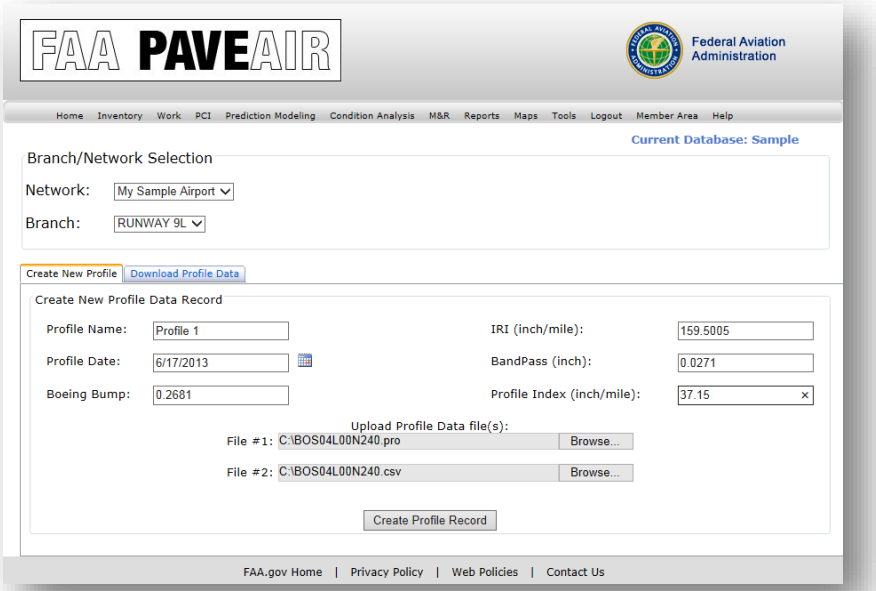
17. Data can also be exported to the AAPTP AirCost spreadsheet and run locally using the "Generate AirCost" button, but the LCCA routine built into PAVEAIR runs in approximately 10% of the time of the spreadsheet version.





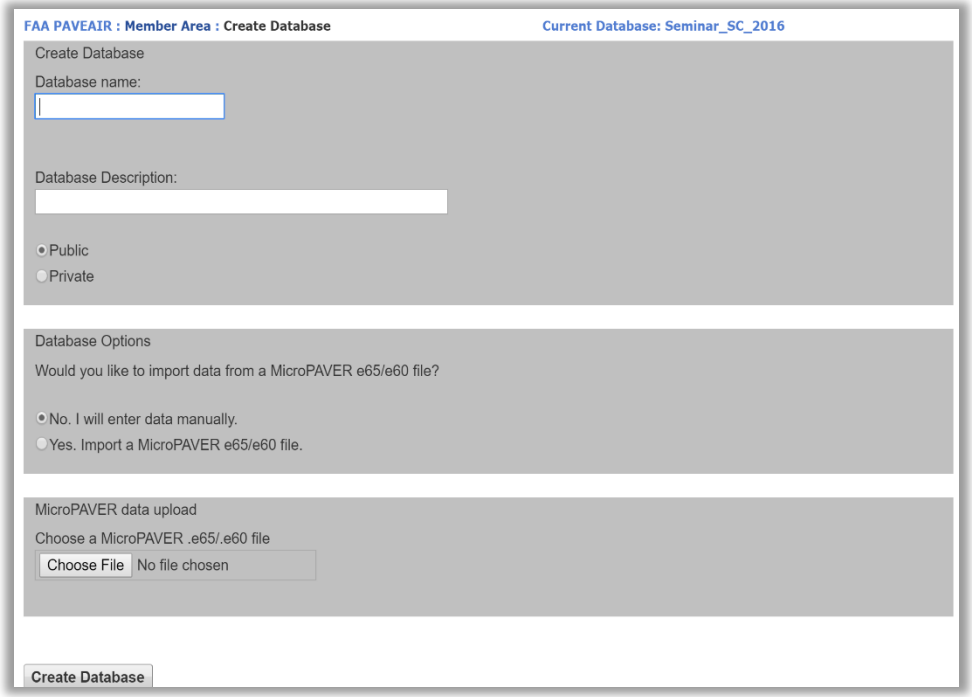
Roughness Profile Data

- Store Airport Pavement Roughness Profile Data
  - Store computed BandPass, Boeing Bump, IRI, and Profile Index
  - Store RAW data in database (.pro, .csv, .txt)
- Download stored RAW data



Sharing Data

- Importing Data
  - MicroPAVER e65 files
  - Existing shapefiles will be imported
- Exporting Data
  - Tools: Database Export
  - Export to XML



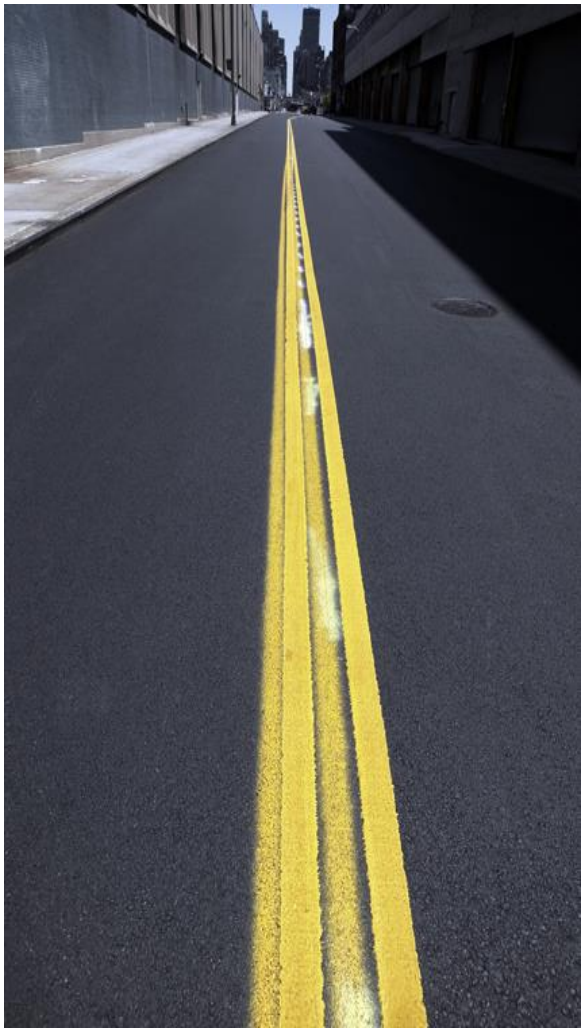
Road Map

Road Map: 2016 - 2018

- PCI Performance Enhancements
- Prediction Modeling Library
- Non-PCI Models
- FAA Pavement Software Conversions
  - WPF versions of COMFAA, BAKFAA, FAARFIELD, FEAFAA, ProFAA, and ProGroove

Road Map: 2018 +

- Improved LCCA Model
- Traffic Module
- Climatic Module
- Integration of FAA applications
  - BAKFAA (Strength Evaluation)
  - COMFAA (PCN Load Rating)
  - FAARFIELD (Thickness Design)
  - ProFAA (Roughness Condition Evaluation)



Questions and Answers