FAA Airport Pavement R&D Section Program Update

Presented to: Airport Pavement Working Group

By: Jeff Gagnon, P.E. Manager ANG-E262

Date: April 15, 2013

Outline

- **R&D Personnel**

- **Completed Projects**
  - 10 Year Airport Pavement R&D Plan
  - F/HWD Round-Up
  - Rigid Pavement Full-Scale Tests (CC6)
  - Reflective Cracking Tests

- **Current Projects**
  - Construction Cycle 7 (Asphalt)
  - Construction Cycle 8 (Concrete)
  - Accelerated Pavement Testing Vehicle (APTV)
  - High Tire Pressure Test Facility (HTPTF)
  - FAA Software Program Integration
  - 40 Year Pavement Life Design Initiative

- **Industry Support / Software Workshops**

NEW PERSONNEL

- **FAA**
  - Two Retirements
    - Dr. Gordon Hayhoe
    - Frank Pecht
  - Additions
    - Wilfredo Villafane - Electronics Technician
    - 1 General Engineer

- **SRA Additions**
  - One Retirement
    - Carole Sharpley
  - Additions
    - 2 Administrative Assistant
    - 2 Civil Engineers
    - 1 Computer Programmer
    - 1 Instrumentation Engineer
    - 1 Engineering Aide

Airport Pavement 10-Year R&D Program

A $129M Investment in Airport Pavement

AIRPORT PAVEMENT 10-YEAR R&D PROGRAM MILESTONE												
Fiscal Year	12	13	14	15	16	17	18	19	20	21	22	Total Cost ($M)
Airport Pavement Design ($35M)												
Project No. 1: Extending Design Life to 40 Years for Airport Pavements												4.5
Project No. 2: Semi-Accelerated Full-Scale (SAFS) Rigid Pavement Test												5.0
Project No. 3: Validated Reflection Cracking Model for HMA Overlay Design												6.0
Project No. 4: Failure Criteria for Top-Down Cracking in Rigid Airport Pavements												3.0
Project No. 5: FAARFIELD-Based ACN/PCN Methodology												4.5
Project No. 6: New LCCA Integrated Design Procedures												12.0
Airport Pavement Materials ($42M)												
Project No. 1: Advanced Characterization of Paving Materials												22.0
Project No. 2: Use of Additives and Nanoparticles to Improve Performance of Airport Pavement Materials												5.0
Project No. 3: Use of Data and Results From Airport Pavement Instrumentation and Field Testing Studies												15.0
Airport Pavement Evaluation ($52M)												
Project No. 1: Improvements to FAA Airport Pavement Software Programs												14.5
Project No. 2: Development of New Roughness Standards for In-Service Airport Pavement												3.0
Project No. 3: Pavement Surface Profile Data Collection, Processing, and Analysis												11.0
Project No. 4: Nondestructive Pavement Testing												23.5

Airport Pavement 10-Year R&D Program

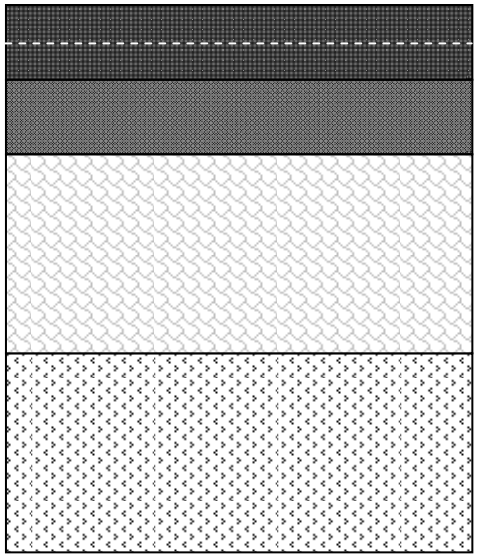
- **Airport Pavement Design**
  - David Brill/Yuanguo Chen
    - Six (6) R&D projects
- **Airport Pavement Materials**
  - Navneet Garg/Harkanwal Brar
    - Three (3) R&D Projects
- **Airport Pavement Evaluation**
  - Al Larkin/Injun Song
    - Four (4) R&D Projects

Completed Projects
F/HWD Round-up

- Objectives
  1. Compare measured results between equipment and pavement instruments
  2. Compare F/HWD with single wheel module
  3. Evaluate specifications & methodologies of existing equipment
  4. Update FAA AC 150/5370-11, “Use of Nondestructive Testing Devices in the Evaluation of Airport Pavements”

Completed Projects F/HWD Round-up

•Asphalt Pavement Test Section

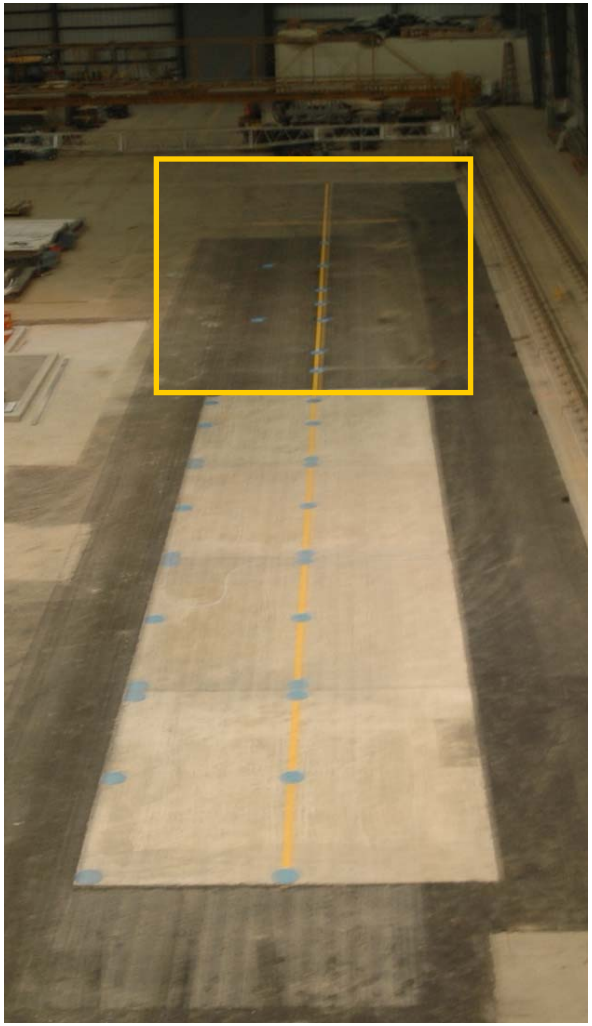


5” P-401 Surface Course

5” P-403 Base Course

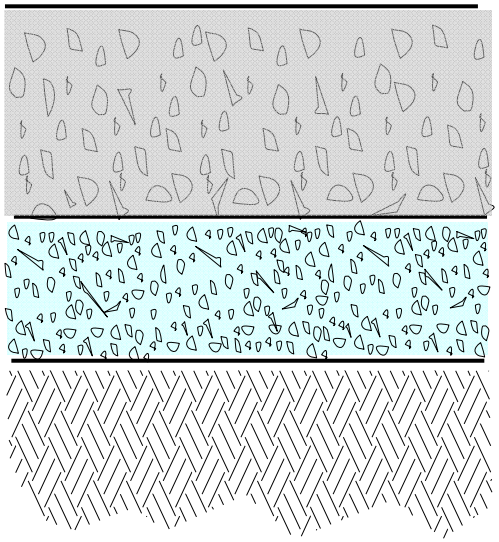
15” P-154 Subbase Course

Medium Strength Subgrade (CBR 6-8)



Completed Projects
F/HWD Round-up

- **Concrete Pavement Test Section**



16” P-501 Concrete Pavement

6” P-306 Econocrete Base

Medium Strength Subgrade (CBR 6-8)

Completed Projects F/HWD Round-up

Federal Aviation Administration

- Airport R&D
- 2010/2011 FWD-HWD Round-up
  - HWD Database
  - Design
    - Facility Layout and Pavement Structure
    - Instrumentation
    - Test Plan
    - Painting Plan
    - Mix Designs
  - Construction
    - Break Data
    - PSPA Data
    - P-154 Density Data
    - Dupont Clay Plate Load Data
    - Dupont Clay CBR, Density and Vane Shear Data
  - Round-Up Binder
  - Test Data
    - FAA KUAB
    - ARA Dynatest
    - McQueen JILS
    - ERI KUAB
    - PaveTesting
    - Carl Bro
    - ERDC Dynatest
    - H/FWD Time Histories
    - NAPTF Test Vehicle
    - Potentiometer Beam Testing
    - Boeing Diptick Testing
  - Pictures
    - Instrumentation
    - Rigid & Flexible
    - Subgrade

Falling/Heavy Weight Deflectometer (F/HWD) Equipment Round-Up

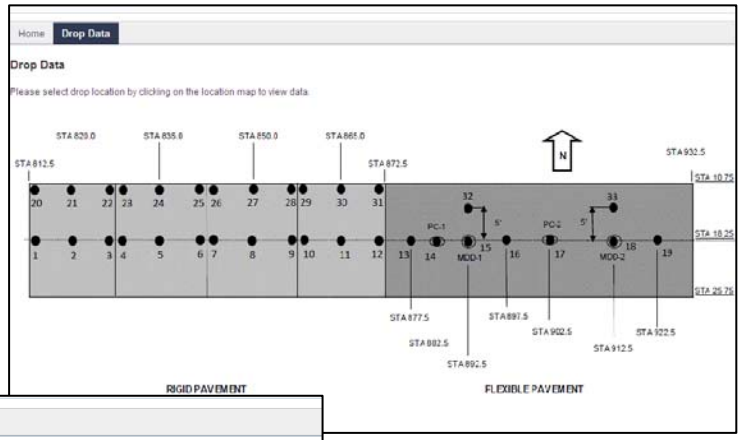
Introduction

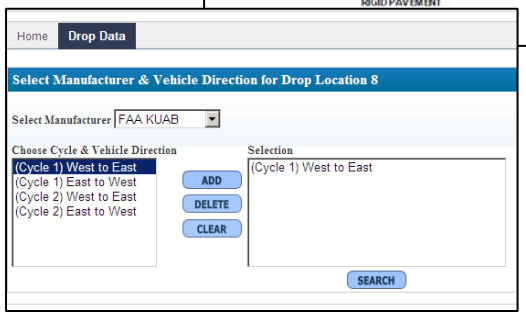
In October and November of 2010 and April of 2011, the FAA hosted a Falling/Heavy Weight Deflectometer (I
backcalculation techniques have proven useful in many areas of airport pavement design, construction, and r
used within Pavement Management System databases for long-term evaluation of pavement structures and t

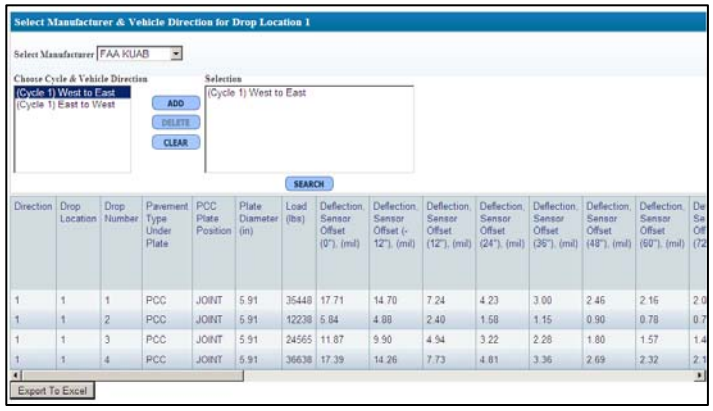
- Recognize the value of deflectometer equipment in pavement structural evaluation.
- Demonstrate the proficiency of the equipment.
- Compare collected F/HWD data to a static and rolling dynamic load using the NAPTF test vehicle.
- Compare collected F/HWD data amongst different manufacturers.
- Compare backcalculated pavement material properties using the different manufactures F/HWD data.
- Evaluate specifications and methodologies for existing F/HWD equipment for use in pavement design an

The project required the development of a controlled test pavement within the NAPTF facility. The Round-Up
and recommended test loads where provided to each participant during the testing process. The original par
multiple test runs both before and after the other participants completed their testing.

Participant	Date of Testing
FAA KUAB	10-7-2010
ARA Dynatest	10-19-2010
JILS	10-19-2010
ERI KUAB	10-20-2010
PaveTesting	10-20-2010
Carl Bro	11-04-2010
ERDC Dynatest	04-20-2011







Completed Projects

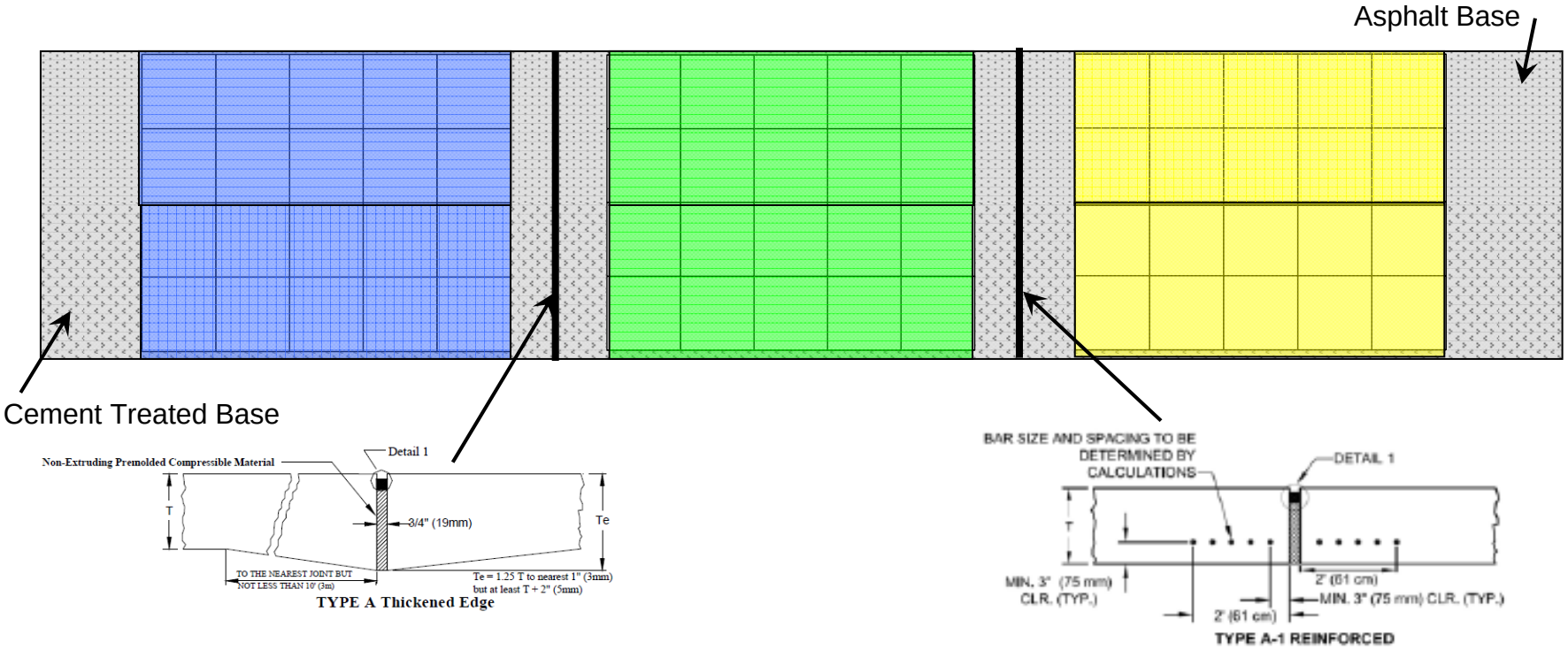
Construction Cycle 6 (CC6) – Rigid Pavement

- **Objectives**
  - Primary
    - The effect of concrete flexural (R) strength on rigid pavement structural life
  - Secondary
    - Perform side-by-side comparisons of Cement and Asphalt stabilized bases
    - Perform side-by-side comparison of thickened edge isolation joint and reinforced isolation joint
    - Provide pavement grooving research
    - Develop a standard procedure for using PSPA on rigid pavement
    - Assess Ground Penetrating Radar (GPR)
    - Study the required compaction requirements under rigid pavements

Completed Projects

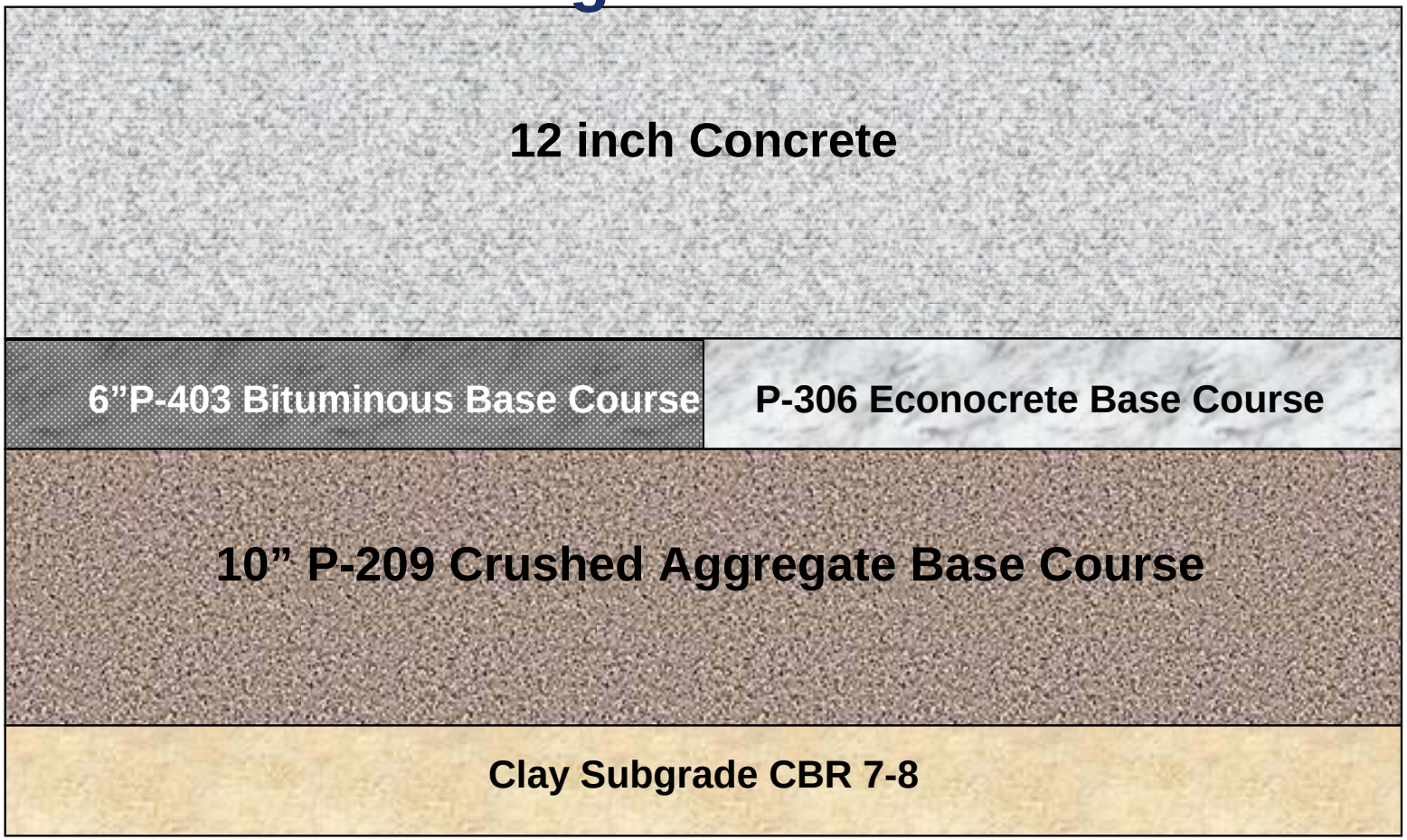
CC6 Layout and Details

- High Strength Concrete
- Med. Strength Concrete
- Low Strength Concrete



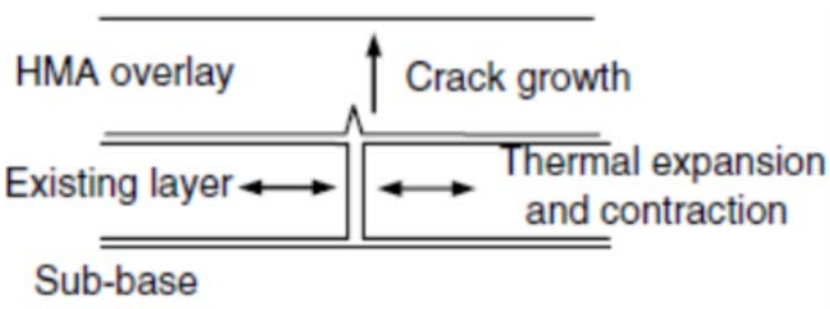
Completed Projects

CC6 Pavement Design



Completed Projects
Reflective Cracking Tests

- **Objective**
  - Evaluate the initiation and propagation of bottom-up reflection cracks due to temperature effect acting alone (thermally induced fatigue), assuming intact PCC slabs.



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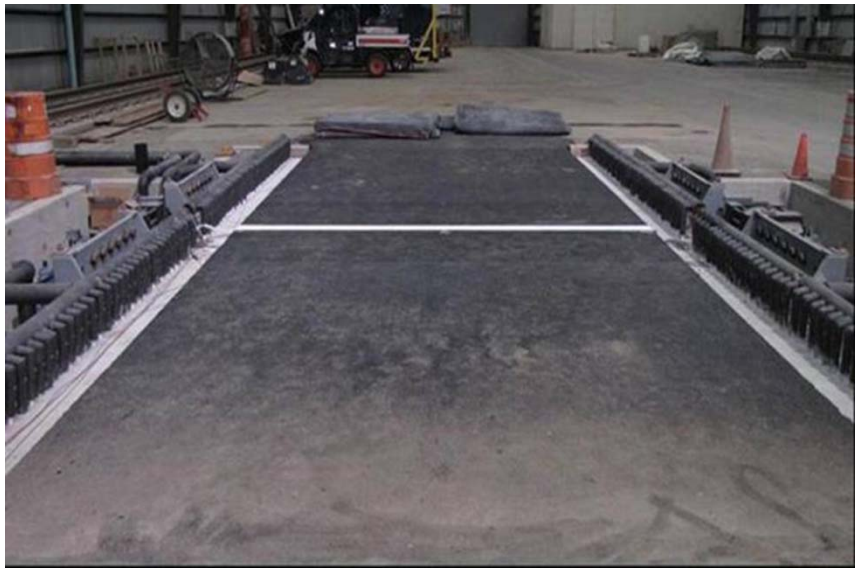
Completed Projects
Reflective Cracking Tests

2012 Test Strip



2013 Test Strip

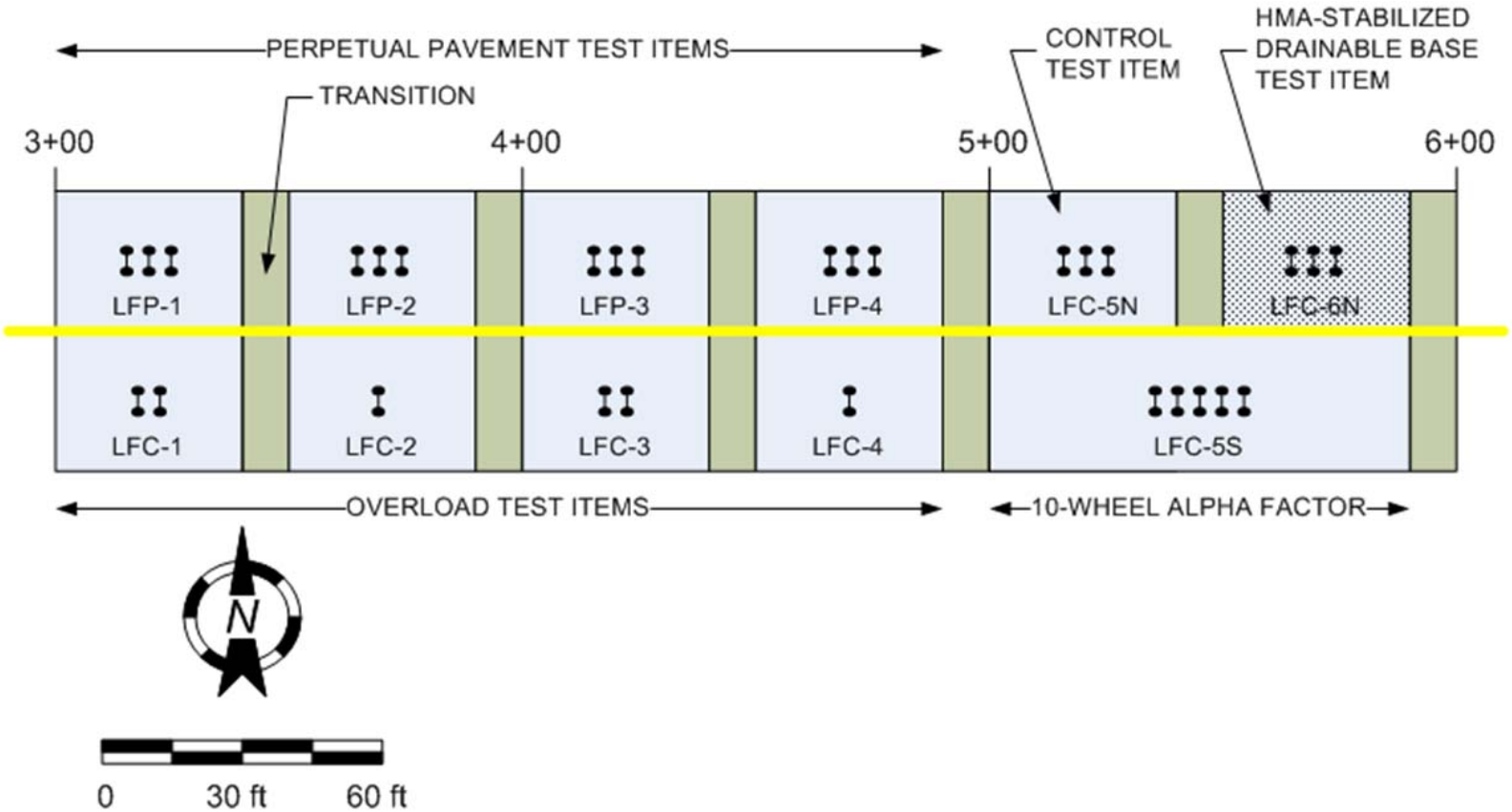
Completed Projects
Reflective Cracking Tests

- **Successful experiment – all systems "worked."**
- **Successfully propagated the reflection crack through the thickness of the overlay in a reasonable number of cycles.**
- **Nearly equal behavior on the two sides.**

Current Projects
Construction Cycle 7 - Asphalt

- **Primary Objectives**
  - **Perpetual Pavement Tests.** Develop “perpetual pavement” design criteria for airport pavements.
  - **Overload Tests.** Determine allowable aircraft overload criteria for flexible pavement.
- **Secondary Objectives**
  - Determine alpha factor for 10-wheel (5D) gear configuration.
  - Study the structural performance of drainable bases.
  - Investigate changes in subgrade CBR with moisture movement in low strength subgrade.

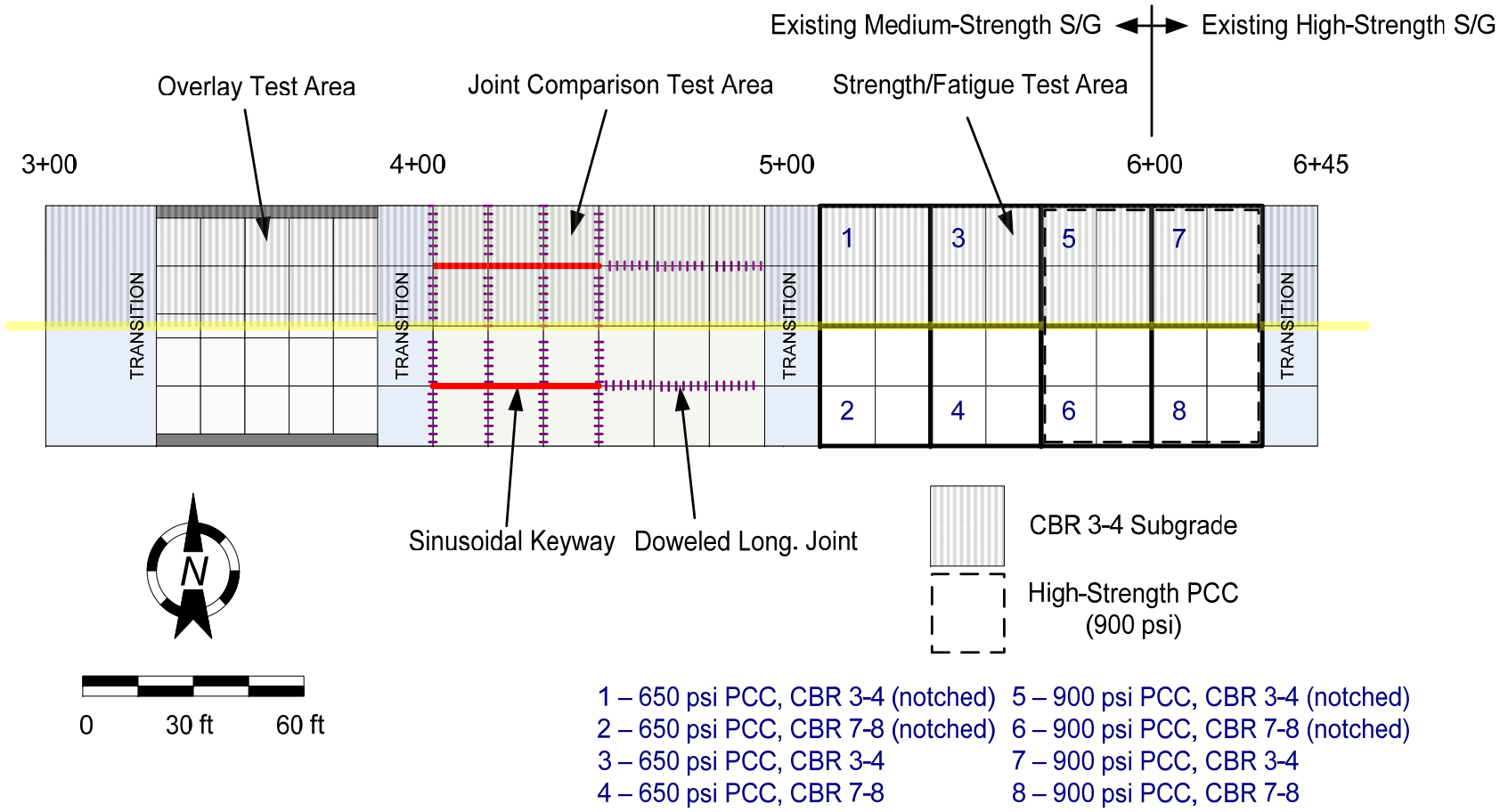
Current Projects
Construction Cycle 7 -Asphalt



Current Projects
Construction Cycle 8 - Concrete

- **Primary Objectives**
  - PCC-on-Rigid Overlay Test. Test PCC overlay on existing PCC with SCI in 50-80 range (Follow-on to CC4 overlay tests).
  - Evaluate Comparative Joint Performance.
    - Longitudinal Joint: doweled versus alternate sinusoidal key.
    - Transverse Joint: doweled versus undoweled (dummy).
  - Improve FAARFIELD Failure Model. Test full-scale slab strength & fatigue strength for different concrete strength and foundation conditions.
- **Secondary Objectives**
  - Develop overload criteria for rigid pavements.
  - Effect of k-value vs. CBR in characterizing rigid subgrade.

Current Projects
Construction Cycle 8 - Concrete

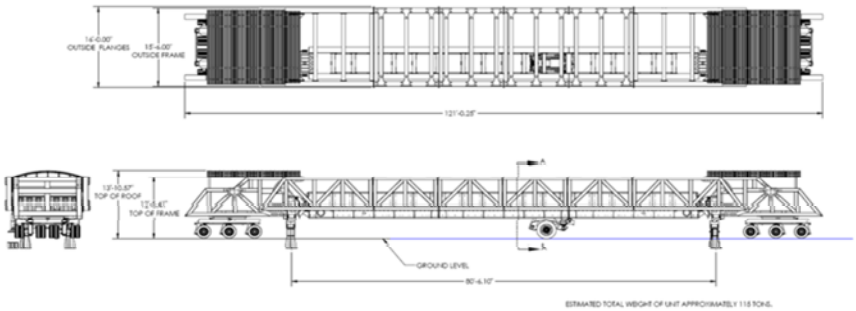


1 – 650 psi PCC, CBR 3-4 (notched)
2 – 650 psi PCC, CBR 7-8 (notched)
3 – 650 psi PCC, CBR 3-4
4 – 650 psi PCC, CBR 7-8
5 – 900 psi PCC, CBR 3-4 (notched)
6 – 900 psi PCC, CBR 7-8 (notched)
7 – 900 psi PCC, CBR 3-4
8 – 900 psi PCC, CBR 7-8

Current Projects
Accelerated Pavement Testing Vehicle

- **Heavy Vehicle Simulator – Airport Version (HVS-A)**
  - Wheel loads - 10,000 to 100,000 lbs.
  - Pavement temperatures up to 150°F
  - Test speeds - 0.17 to 5 mph
  - Single and Dual-Wheel configuration.
  - Single wheel will be radial aircraft tires size 52x21.0R22
  - Dual wheel assembly is designed to accommodate tires of smaller sizes (such as Boeing 737-80(
  - Wander Width – 6 feet

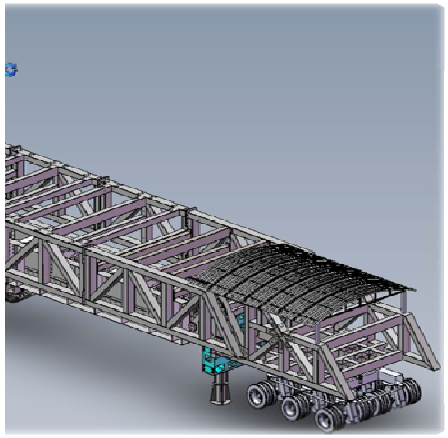
Heavy Vehicle Simulator – Airports (HVS-A)
- Mfr. by Dynatest in USA.
- Anticipated delivery & on-site assembly June 2013.



Current Projects

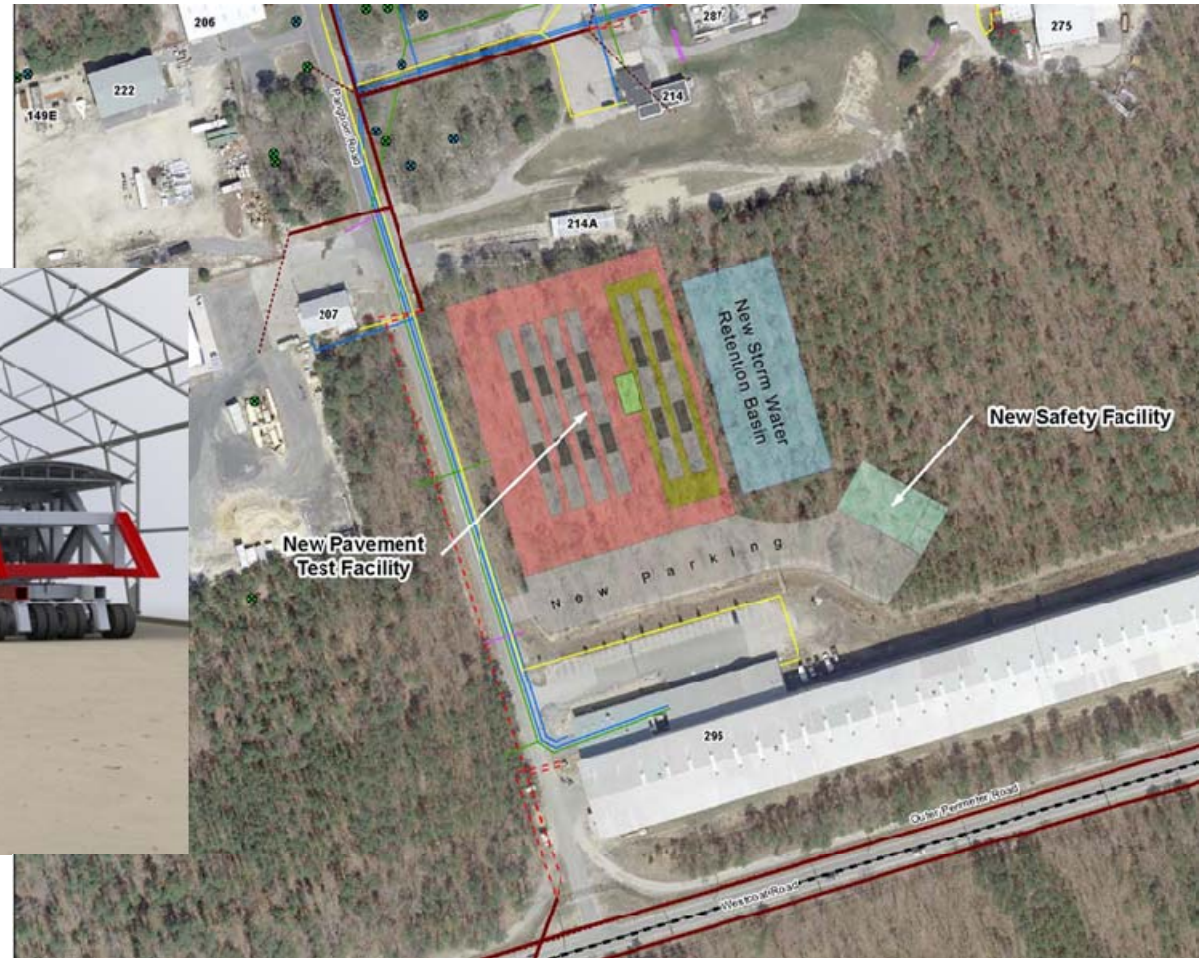
High Temperature Pavement Test Facility (HTPTF)

- **Purpose**
  - Conduct full ormance prediction m ory tests.
  - Provides ca yers in situ under enviro ions.



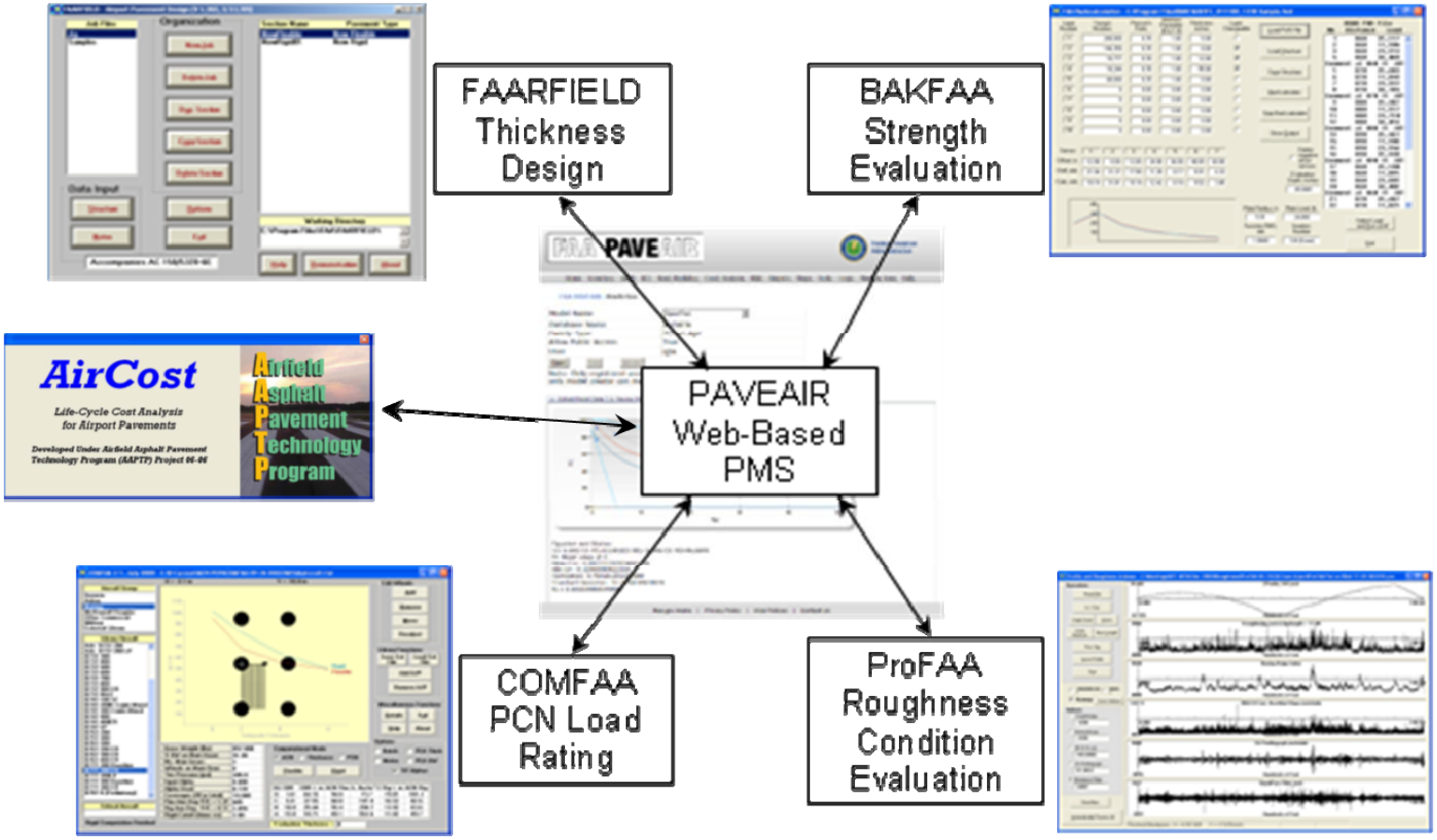
Current Projects

High Temperature Pavement Test Facility (HTPTF)



Current Projects

FAA Software Program Integration



FAA Software Program Integration

•FAARFIELD

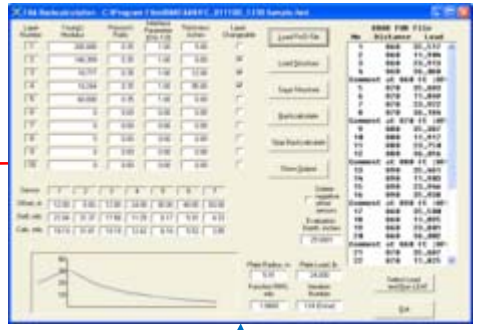
Pav't X-Section

Pav't Layer Properties

Aircraft Traffic

New Pav't Design

BAKFAA



Pav't Layer Properties

Pav't X-Section

F/HWD Data

New Pav't Design

Cost Information

Design Life

LCCA for New Pav't Design

Current Projects
40 Year Pavement Life Design Initiative

- **Work has Started on a pilot program**

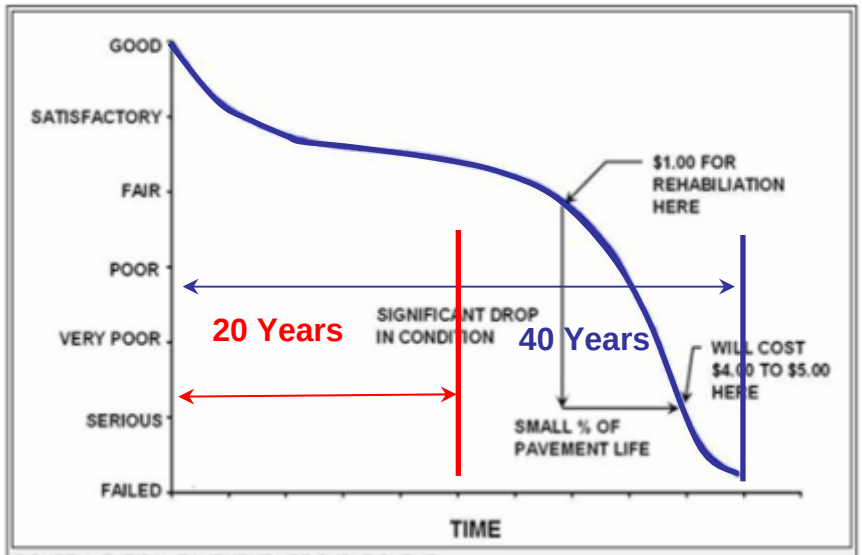
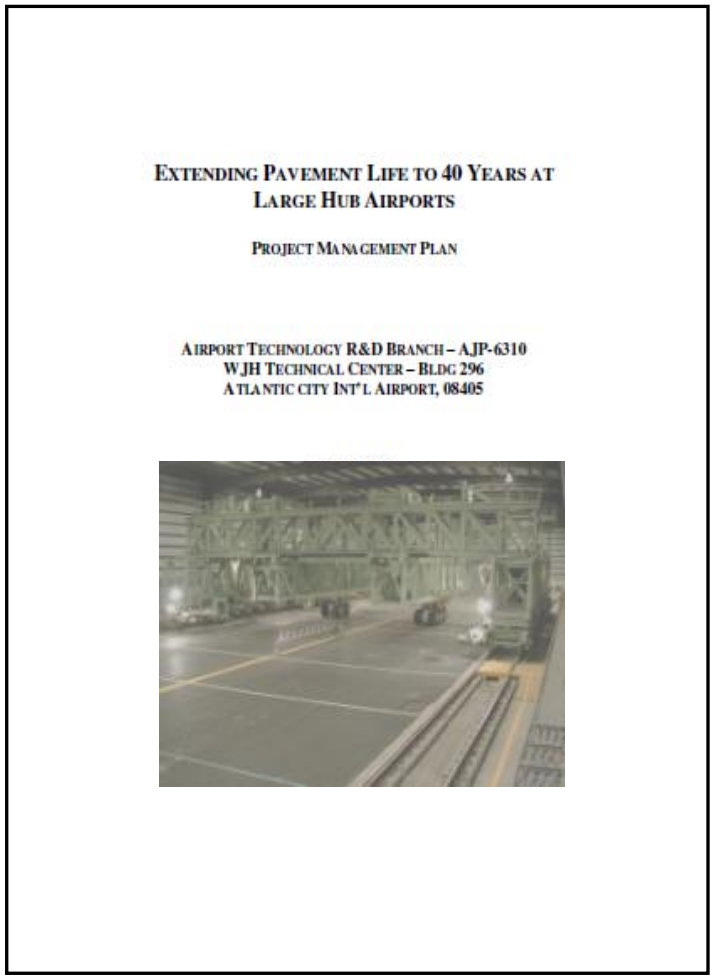


FIGURE 1- TYPICAL PAVEMENT LIFE CYCLE CURVE


EXTENDING PAVEMENT LIFE TO 40 YEARS AT LARGE HUB AIRPORTS

PROJECT MANAGEMENT PLAN

AIRPORT TECHNOLOGY R&D BRANCH – AJP-6310
WJH TECHNICAL CENTER – BLDG 296
ATLANTIC CITY INT'L AIRPORT, 08405

Current Projects
40 Year Pavement Life Design Initiative

- **Biggest Challenge**

Definition #1: A pavement has reached the end of its useful life when the PCI decreases below $PCI_{LowerThresh}$ and cannot be restored to a PCI of greater than $PCI_{UpperThresh}$ with a P percent probability of remaining above $PCI_{LowerThresh}$ for a period of 10 years.

Propose: $PCI_{LowerThresh} = 70$ $PCI_{UpperThresh} = 95$

Definition #2: A pavement has reached the end of its useful life when the DL decreases below $DL_{LowerThresh}$ and cannot be restored to a DL of greater than $DL_{UpperThresh}$ with a P percent probability of remaining above $DL_{LowerThresh}$ for a period of 10 years.

Where: DL = Distress Level = some combination of pavement distresses taken together or separately. That is, if taken separately, different threshold levels could apply to different distresses. The DL could include PCI, roughness, friction, and etc.

Current Projects
40 Year Pavement Life Design Initiative

- **Benefits**
  1. Sustainability
  2. Life Cycle Assessment (LCA)
  3. Improved pavement life prediction
  4. Development of new materials and new mix designs
  5. Development of new performance specifications
  6. Development of best practices for M&R

Industry Support / Workshops

- **Airport Consultants Council (ACC)**
- **Asphalt Institute(AI)**
- **American Association of Airport Executives (AAAE)**
- **American Concrete Pavement Association (ACPA)**
- **American Society of Civil Engineers (ASCE)**

Industry Support / Workshops

THANK YOU

QUESTIONS