Airfield Pavement Reconstruction Alternatives

ICAO ACR/PCR Workshop

Presented by: **Harold Muniz**
Airfield Pavement Engineer
FAA Headquarter, AAS-110

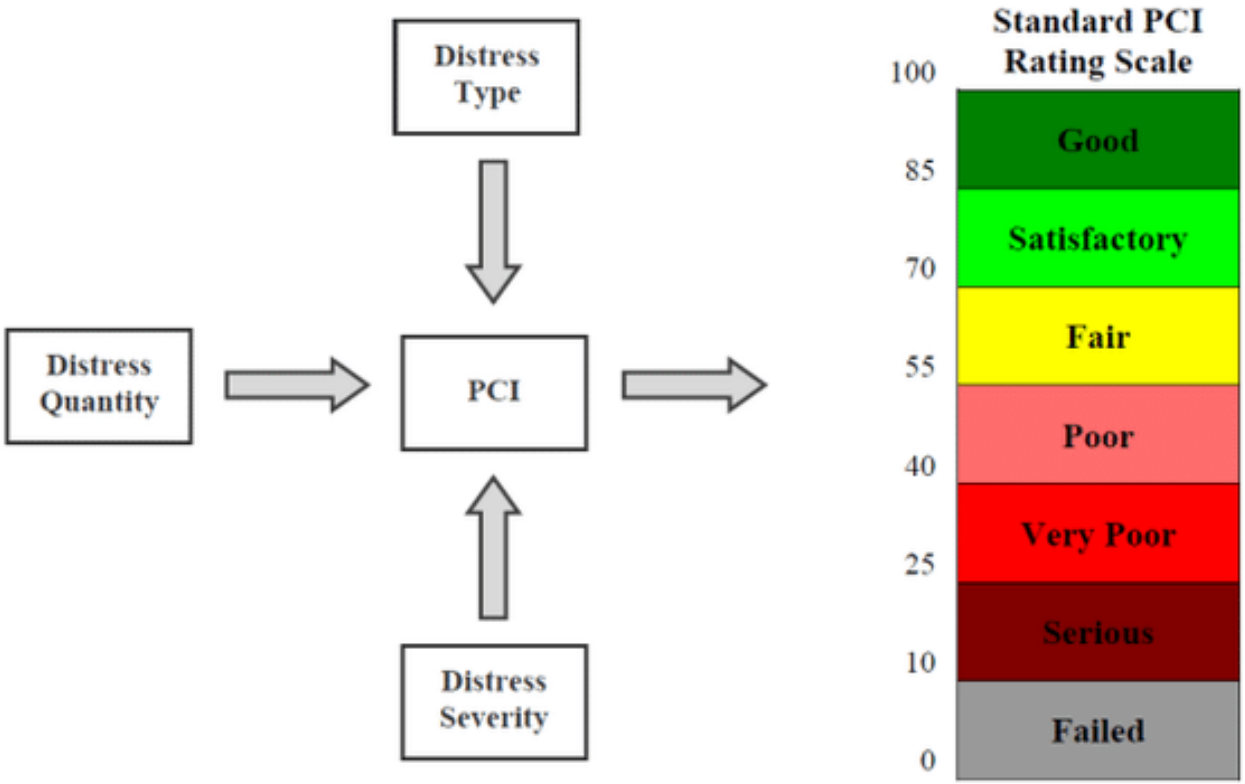
Overlays

- Structural Overlays
  - Flexible Overlay of Flexible
  - Flexible Overlay of Rigid
  - Rigid Overlay of Rigid
    - Bonded (requires FAA Approval)
    - Unbonded
  - Rigid Overlay of Flexible
- Functional Overlays
- Alternate Reconstruction of Existing Pavement
  - PCC Rubblization
  - Full Depth Reclamation

Required Inputs for Overlay Design

- **Existing Pavement Structure**
  - Layer Types and Thicknesses
  - Modulus for all layers (may require user defined layers)
  - Flexural strength of concrete
  - Subgrade strength
  - Existing Pavement Condition
    - Rigid Pavement requires Structural Condition Index (SCI)
    - Flexible requires engineering judgement
- **Traffic**
  - Airplane Type and Characteristics
  - Annual Departures
  - Annual Growth

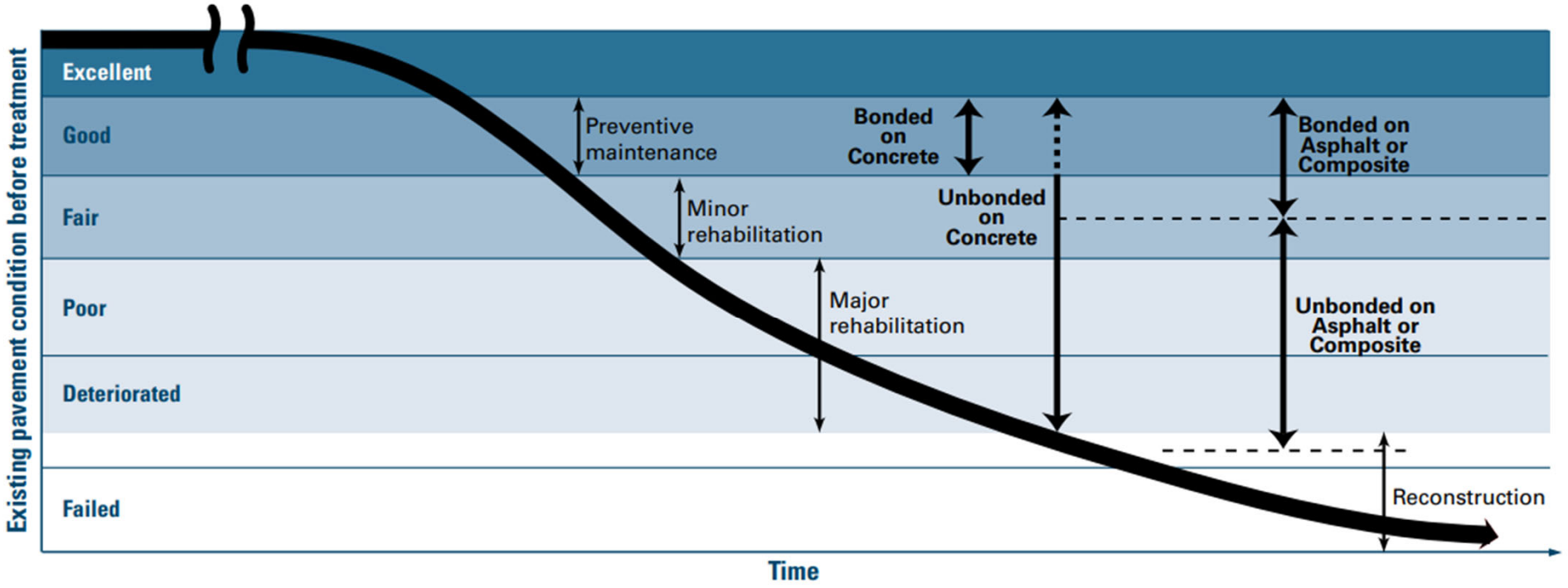
Pavement Condition Assessment



Pavement Condition Assessment

- **Structural Condition Index (SCI)- Used to express structural condition of existing rigid pavement.**
  - Computed using only structural distresses
- **SCI will always be greater than or equal to PCI**
- **SCI = 80 is the FAA definition of structural failure**
  - 50% of panels in traffic area have a structural crack
- **Pavement with SCI = 80 and few durability issues can appear to be in surprisingly good condition**
  - This is why we care about functional life
- **Pavement with SCI > 80 but with durability issues can look severely failed**

Overlay - Existing Pavement Condition



CP Tech Center

Overlay Design Life (AC 150/5320-6G)

- **Design overlays for a 20-year structural life from time of overlay**
- **A design life less than 20 years (minimum of 10 years) may be considered if:**
  - The original pavement is more than 15 years old at the time of overlay, and;
  - The primary purpose of the overlay is functional rehabilitation of the pavement surface (i.e.) where the underlying pavement retains considerable structural integrity.
- **Document and support the design life used in the engineer's report**

HMA Overlay HMA

- **Nonstructural Asphalt Overlays -** correct functional problems such as restoring the crown, correcting longitudinal profile, and/or improving skid resistance.
  - Improve surface characteristics
  - Minimum overlay thickness is dependent on gradation (no calculation required)
  - Consider minimum construction thicknesses for the P401/P403 150/5370-10H
  - Leaving less than 2” of AC pavement can be problematic
- **Structural Overlay Asphalt Overlay -** consider when additional capacity and is needed. Can also correct functional problems.
  - Consider impacts of increased thickness
  - 3” minimum overlay thickness
- An interlayer placed between the existing pavement and the overlay to improve overlay performance

HMA Overlay Over PCC

- Generally used to slow rate of deterioration of the rigid layer with signs of some structural distress.
- Good candidates have an SCI <100 and >80
- Can be used to strength pavement to accept heavier aircraft.
- FAA requires a minimum 3-inch HMA overlay on PCC
  - Thin overlays have a tendency to delaminate as they deteriorate
  - Need to consider minimum P-401 lift thickness guidance

- FAARFIELD is trying to protect PCC from falling below SCI of 40 on aggregate base, 57 on stabilized base
  - FAARFIELD does not consider reflective cracking, delamination, or other deterioration in computed structural life
  - Often overlay functional life is significantly less than 20 years, especially when it is thin
  - Bond is the #1 concern; crack maintenance is the 2nd concern that airports must consider when selecting an HMA overlay of PCC

Rigid Overlay

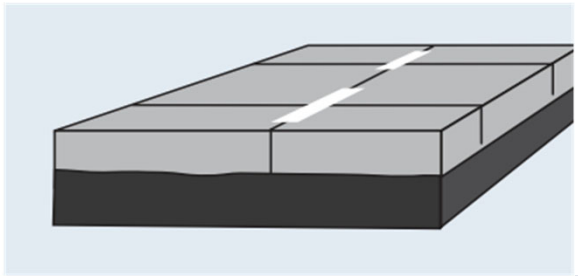
- **Bonded Overlay -** considered when there is a need to increase capacity of existing pavement to support additional aircraft.
  - Layers are assumed to act as one monolithic layer
  - Underlying pavement should be in good condition
  - Not very common
  - Require FAA approval
- **Unbonded Overlays -** major rehabilitation effort restores/increases a pavements structural and functional life
  - New PCC acts independent from base layer
  - No extensive pre-overlay repairs generally required
  - Bond-breaker may be asphalt, geosythentic, or choke stone
  - FAARFIELD iterates overlay thickness until it finds a design thickness that produces SCI = 80 for the overlay at the end of the 20-year design life

Rigid Pavement Over Asphalt

- **Uses same basic design methods as new Rigid Design**
  - Allows HMA surface modulus value to be used under PCC instead of stabilized base modulus
- **Overlay will design until a CDF of 1.0 is reached, or minimum thickness is reached**
  - For overlays minimum thickness

  of 5 inches is allowed
- **Poor drainage can cause stripping**

Unbonded Rigid over Asphalt

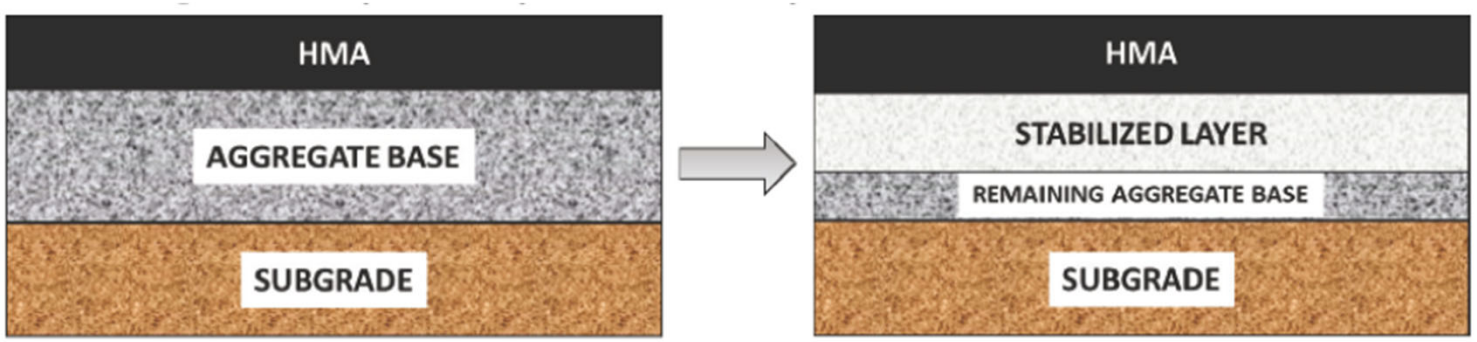


FAA Southern Region PCC Overlay

State / Year	Airport	RW / TW / Apron
Florida		
1996	New Smyrna Beach [1]	TW & Apron, 3.5-inches (or less), fibers
2003	Fernandina Beach	RW (6-in) & TW (5-in)
2006	Williston	RW (5-in, UBOA & 4-in, UBOC)
Georgia		
1997	Moody AFB	6000' of RW used UBOA, 1000' used UBOC
2008	Cobb County	Runway (7-in)
2011	Augusta Regional	Runway 17-35 (14-in)
North Carolina		
2016	Wilmington International	N. GA Apron (9-in, UBOC)
South Carolina		
2004	Williamsburg County	Apron (5-in)
2008	Marion County	Apron (5-in)
2009	Lancaster County	Runway (7.5-in)
2009	Charleston Executive	Runway (11-in, UBOC)
2011	Berkeley County	Runway (9-in)
2012	Laurens County	Runway (5-in) & Taxiway
2014 - 18	Greenwood County	Runway (5-in) & Taxiway
2018	Grand Strand (N Myrtle Beach)	Runway (7.5-in)
2019	Darlington County	Runway (7-in)
2024	Lexington County	TW A (6-in)
2024	Conway	RW (5-in)
2024	Aiken Regional	RW (6-in)
Tennessee		
2000	Savannah-Hardin County [2]	Runway (4-in, fiber reinforced concrete mix)
2020	Jamestown Municipal	Runway (5-in)

Full Depth Reclamation of In-place HMA

- **Existing HMA, base, subbase layers pulverized and mixed to create a homogeneous base material**
  - May include stabilization to create construction platform, or improve modulus
    - Fly ash, Portland cement, emulsified or foamed asphalt
  - May include blending of virgin aggregate to control gradation
  - Lab testing should be completed to assess material strength



Full Depth Reclamation of In-place HMA

- Must Determine;
  - Existing pavement profile
  - Depth of pulverization and mixing
  - Quality and gradation of base material
  - Extent of stabilization (if required)

- Design in FAARFIELD as User Defined Layer
  - Modulus can range from 25,000 psi to 500,000 psi depending on geotechnical results
  - For airports serving aircraft less than 30,000 lbs can usually place new surface directly on FDR
  - For airports serving aircraft over 30,000 lbs a base material may be required
  - FAA approval is required for use at airports serving aircraft over 60,000 lbs

- FDR is specified using **P-207** (AC 150/5370-10H)

Full Depth Reclamation of In-place HMA

- Porter County Regional Airport
- Completed in 2, 8-week phases
- FDR accomplished on Rwy & Twy
- Approx. 10” in depth
- Cement Stabilization

PCC Rubblization or Crack and Seat

- **Both methods remove the structural capacity of the PCC to prevent reflecting cracking.**
  - Rubblization is the most common method, Crack and Seat has faded in popularity
- **Design in FAARFIELD as a User Defined Layer**
  - Modulus is defined based on PCC thickness
    - 6-8 inches: E = 100,000 – 135,000 psi
    - 8-14 inches: E = 135,000 – 235,000 psi
    - Over 14 inches E = 235,000 – 400,000 psi
  - Other moduli can be select with proper analysis in engineer's report
- **If performing Rubblization or Crack and Seat refer to EB-66**
  - **P-215** is included in **EB-66** as a standard specification

PCC Rubblization or Crack and Seat

HMA Overlays of FDR or Rubblized PCC

- **Design process is similar to HMA overlay of Flexible Pavement**
  - FDR or Rubblized layer modeled as User Defined Layer
  - Modulus set based on engineer's analysis
  - Thickness set based on existing pavement thicknesses
    - Remember in FDR your final thickness may be different depending on compaction or introduction of virgin aggregates
- **FAARFIELD will design overlay thickness**
  - With FDR you may be able to balance modulus with overlay thickness if you ensure the material can achieve the modulus you design for
- *Don't forget that neither FDR or Rubblization can replace stabilized base if required (without FAA approval)*

PCC Overlay of FDR or Rubblized PCC

- Model in FAARFIELD as a New PCC Pavement
- FDR or Rubblized PCC modeled as User Defined layer using thickness and modulus determined from geotechnical investigation
- For PCC pavement it is easier to justify Rubblization or FDR in place of stabilized base
  - Can Rubblized concrete achieve similar strengths to CBR 100 material?
  - Can FDR be stabilized enough to achieve modulus similar to stabilized base?
- If you are going to propose rubblization or FDR make sure you have done your homework:
  - Discuss the option during development of design scope and fee. Don't wait until preliminary design to start, you will not have the scope or budget to do it right!!!!

Review

- Evolution of Airfield Pavement
- Concepts & Design Considerations
- Materials & Specifications
  - Aggregate Layers
  - Stabilized Materials
  - Frost Consideration
- Reconstruction Alternatives
  - Overlays
  - Alternative Methods for Existing Pavements

QUESTIONS?

Harold Muniz, Airfield Engineer
harold.muniz-ruiz@faa.gov
(202) 267-5190