Overview of FAA Guidance on Pavement Design & Construction

Advisory Circulars and Engineering Briefs

Presented to: ACPTP GA Concrete Workshop

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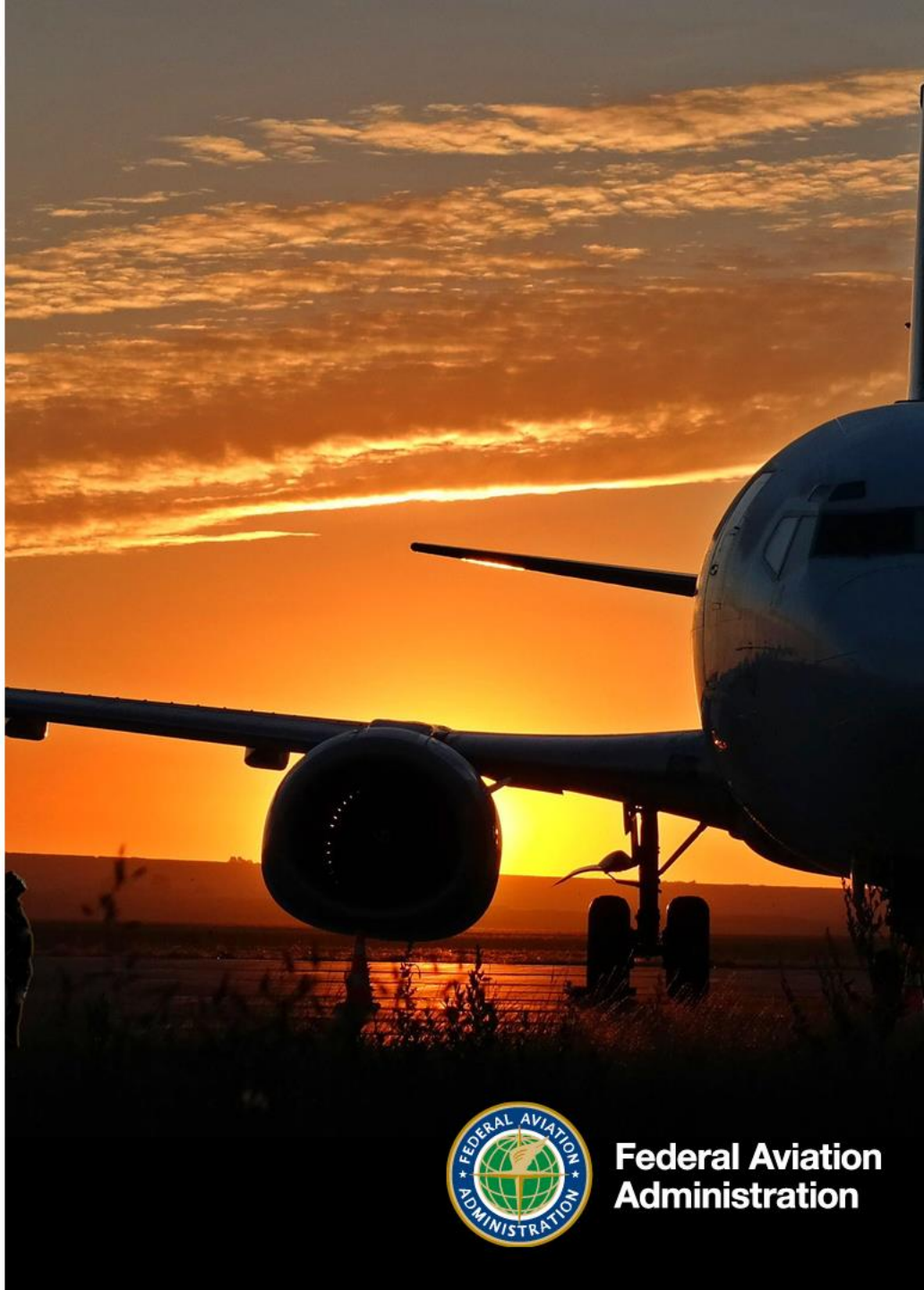
Date: February 24, 2025



Airports in the United States

- **19,853 airports in the NAS**
  - 14,784 private-use airports
  - 5,069 airports open to public
- **3,287 NPIAS Airports**
- **519 airports certificated under Part 139 (commercial service with 9 or more seats)**
- **383 Primary Airports (>10,000 annual enplanements)**

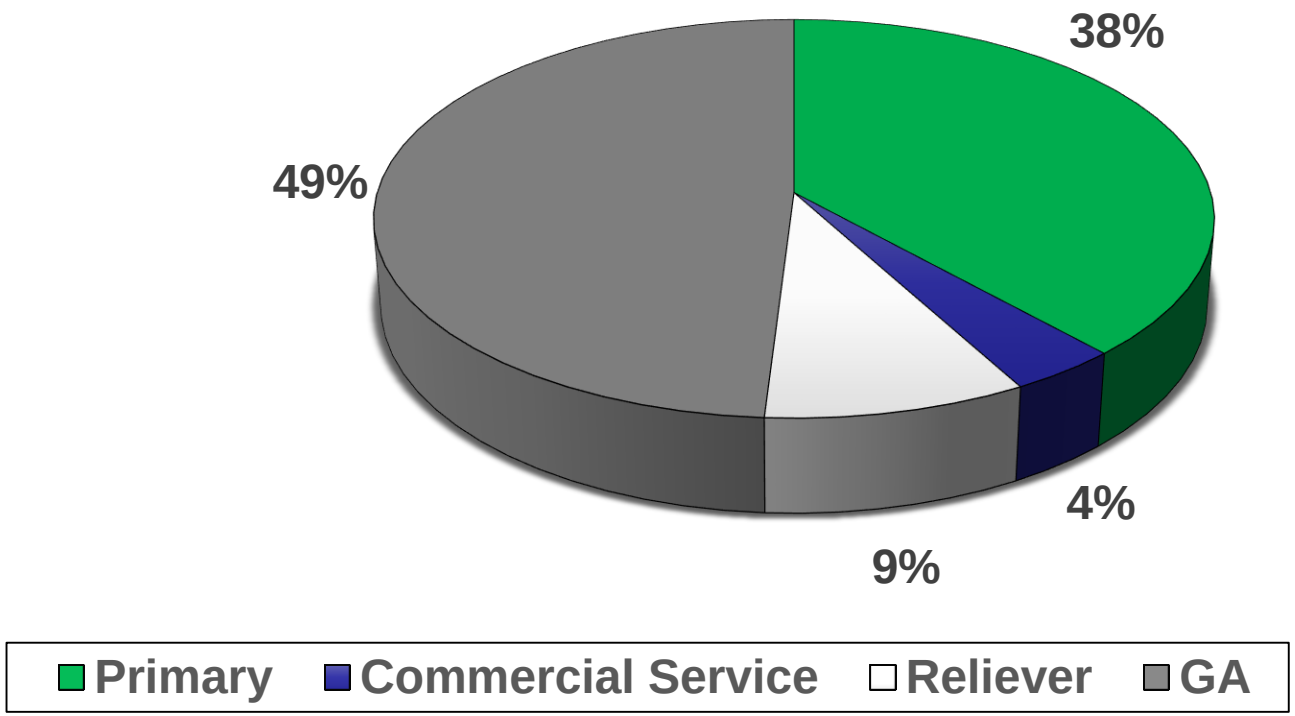
Paved Areas (NPIAS Airports)

	Area (millions sy)	Area (millions sq m)	Lane Miles (~14’ wide)
Runway	271	226	~33,000
Taxiway*	105	88	~13,000
Apron**	81	68	~10,000
Total	457	382	~56,000

* Taxiway area estimated at 38.6% of runway area

** Apron area estimated at 29.8% of runway area

Runway Surface Area vs. Airport Category



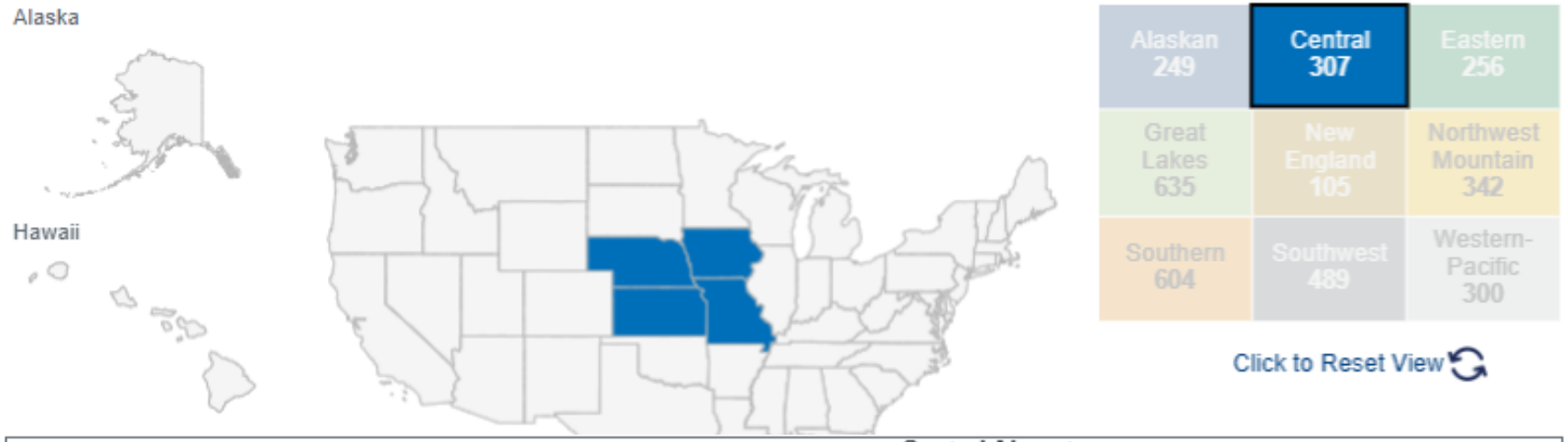
NPIAS Airports

Region	Airport Role					Hub Size				Grand Total
	National	Regional	Local	Basic	Unclassif..	Large Hub	Medium ..	Small Hub	Nonhub	
Alaskan		1	56	155	14		1	1	21	249
Central	7	34	137	96	11		3	4	15	307
Eastern	13	68	81	28	24	7	2	8	25	256
Great Lakes	22	104	302	124	21	4	4	6	48	635
New England	3	24	37	15	8	1	1	5	11	105
Northwest Mountain	8	43	141	85	10	3	2	7	43	342
Southern	26	159	215	98	30	7	8	23	38	604
Southwest	23	94	172	106	49	3	5	9	28	489
Western-Pacific	20	59	80	71	23	6	7	11	23	300
Grand Total	122	586	1,221	778	190	31	33	74	252	3,287

NPIAS Central Region Airport

National Plan of Integrated Airport Systems (NPIAS) 2025–2029: Appendix A - List of NPIAS Airports

Click for Details



State	Grand Total	Central Airports							
		Airport Role					Hub Size		
		National	Regional	Local	Basic	Unclassified	Medium Hub	Small Hub	Nonhub
Iowa	79		10	41	19	4		2	3
Kansas	80	4	9	28	30	4		1	4
Missouri	76	3	11	38	17	1	2	1	3
Nebraska	72		4	30	30	2	1		5
Grand Total	307	7	34	137	96	11	3	4	15

FAA Pavement Guidance Documents

United States Department of Transportation

Federal Aviation Administration

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Home / Airports / Engineering, Design, & Construction Standards / Airport Pavement Design and Construction

- Overview
- Airport Compliance
- Airport Financial Assistance
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  - Overview
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  - Aircraft Characteristics Database
  - Airport Airspace Analysis

Airport Pavement Design & Construction – Associated with Advisory Circulars 150/5320-6, 150/5335-5, 150/5370-10, 150/5380-6, and 150/5380-7

More than half of all Airport Improvement Program funds go toward constructing or rehabilitating runways, taxiways, and aprons. FAA pavement standards help protect this investment by ensuring pavements last as long as possible with the least amount of maintenance.

- Advisory Circulars - All 150 Series ACs
  - AC 150/5100-13, Development of State Aviation Standards for Airport Pavement Construction
  - AC 150/5320-5, Surface Drainage Design
  - AC 150/5320-6, Airport Pavement Design and Evaluation
  - AC 150/5370-10, Standards for Specifying Construction of Airports
    - Airport Construction Standards (access to individual standards)
  - AC 150/5370-11, Use of Nondestructive Testing in the Evaluation of Airport Pavements
    - Backcalculation Software (BAKFAA)
  - AC 150/5380-6, Guidelines and Procedures for Maintenance of Airport Pavements
  - AC 150/5380-7, Airport Pavement Management Program (PMP)
  - More Pavement Design ACs »
- Airport Design Software
- Airport Design and Engineering Standards (Quick Reference)
- Engineering Briefs

Federal Aviation Administration

FAA Pavement Advisory Circulars

Advisory Circular	Date	Update	Title
AC 150/5000-15B	2013	FY25	Announcement of Availability of Airport-Related Research and Development Products
AC 150/5100-13C	2019		Development of State Standards for Non-primary Airports
AC 150/5320-6G	**2021**	**FY26**	**Airport Pavement Design & Evaluation**
AC 150/5320-5D	2013		Airport Drainage Design
AC 150/5320-12C	1997		Measurement, Construction & Maintenance of Skid Resistant Airport Pavement Surfaces (incl. Changes 1-8 through 2007)
AC 150/5335-5D	2022		Standardized Method of Reporting Airport Pavement Strength - PCR
AC 150/5370-10H	**2018**	**FY26**	**Standards for Specifying Construction of Airports**
AC 150/5370-11B	2011		Use of Non-Destructive Testing in the Evaluation of Airport Pavements
AC 150/5370-12B	**2015**	**FY26**	**Quality Management for Federally Funded Airport Construction Projects**
AC 150/5370-16	2017		Rapid Construction of Rigid (Portland Cement Concrete) Airfield Pavements
AC 150/5380-6C	2014		Guidelines & Procedures for Maintenance of Airport Pavements
AC 150/5380-7B	2014		Airport Pavement Management Programs (PMP)
AC 150/5380-9	2009		Guidelines & Procedures for Measurement of Pavement Roughness

FAA Pavement Engineering Briefs

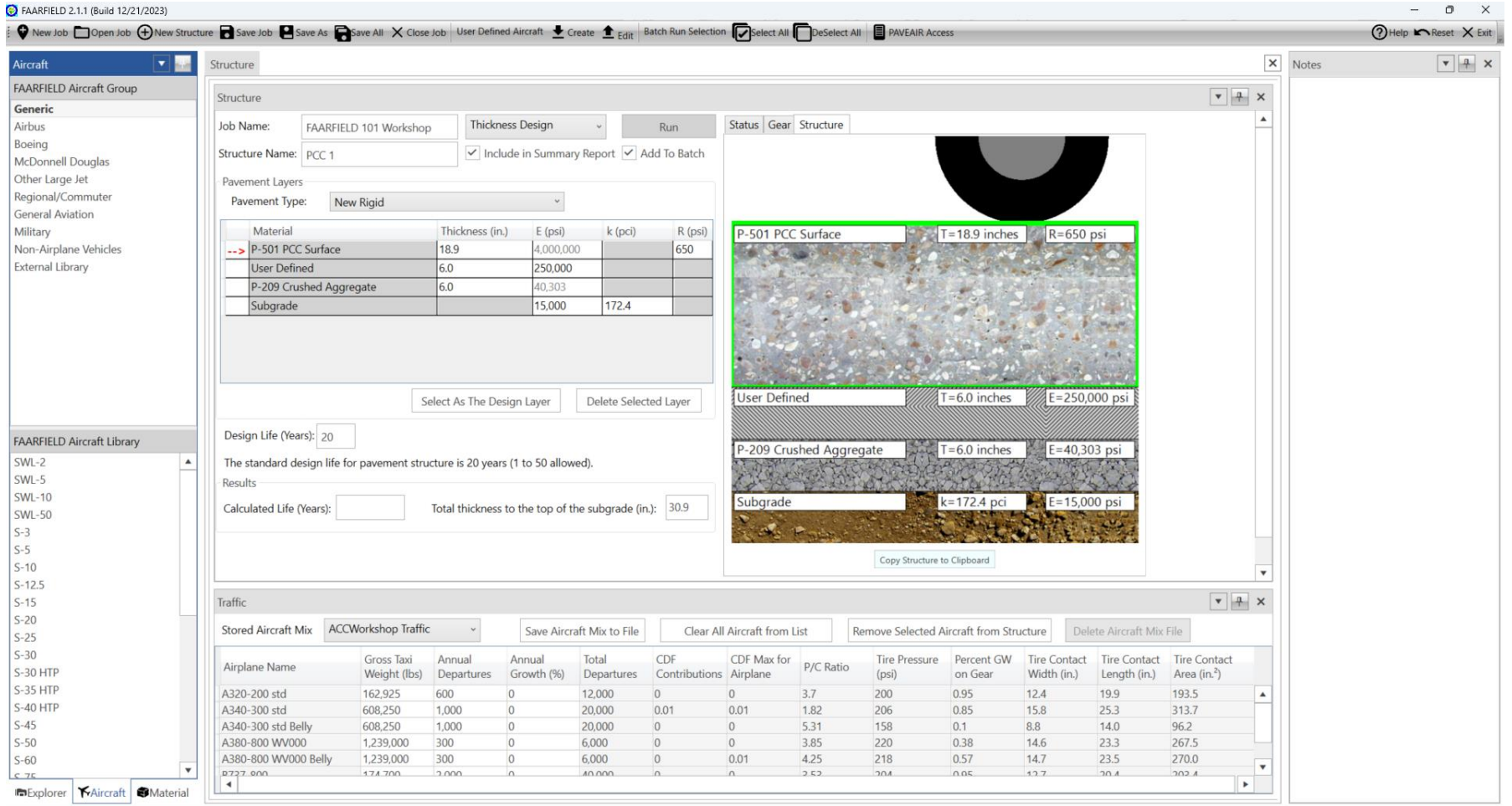
Engineering Brief	Title
EB-106	**Guidance for the Implementation of Changes in Industry Cement Standards into FAA Standard Specifications**
EB-102	**Asphalt Treated Permeable Base**
EB-66	**Rubblized Portland Cement Concrete**
EB-57	Extended Q-Value Table for Estimating Percent of Lot Within Limits (PWL)
EB-56	**Development of Revised Acceptance Criteria for Item P-401 and Item P-501**
EB-42	Geocomposite Edge Drains
EB-34A	**Referee Testing of Hardened Portland Cement Concrete Pavement – Percentage within Limits Revision**

FAA Pavement Computer Programs

Software	Description
FAARFIELD v 2.1	Airport Pavement Design and ACR/PCR Evaluation
COMFAA 3.0	ACN/PCN Evaluation
COMFAA 3.0 Support	Excel Spreadsheet to assist with PCN evaluation
BAKFAA	Back-calculation of modulus from NDT Testing
PROFAA	**Analysis of Pavement Profiles and Roughness**
FAA PaveAir	Web-based pavement management and LCCA software
PWL Spreadsheets	**Tools to assist in calculation of PWLs for P-401 and P-501 acceptance**

Note: updates to programs are periodically posted
Be sure to check that you are using the latest version

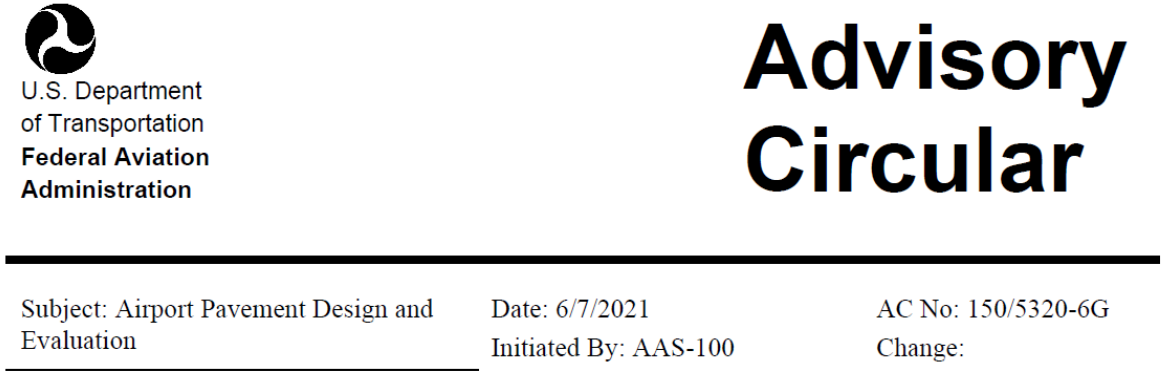
FAARFIELD 2.1.1 (released 12/21/2023)



Federal Aviation Administration

FAARFIELD Training Video Series

AC 150/5320-6G *Airport Pavement Design and Evaluation*


U.S. Department
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Federal Aviation
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Advisory Circular

Subject: Airport Pavement Design and Evaluation | Date: 6/7/2021 Initiated By: AAS-100 | AC No: 150/5320-6G Change:

- **Released 6/7/2021**
  - *Currently under revision*
- **FAARFIELD 2.0 released with AC**

Chapters:

1- Airport Pavement Functions
2- Soil Investigation and Evaluation
3- Pavement Design
4- Pavement Maintenance, Rehabilitation & Reconstruction
5- Pavement Structural Evaluation
6- Pavement Shoulder Design
Appendices A- K

Pavement Design Life vs Functional

1.6.2

- **1.6.2.1** *With proper design, materials, and maintenance any pavement type can provide a desired service life...However, no pavement structure will perform for the desired life without using* ***quality materials installed properly and maintained*** *with timely routine and preventative maintenance.*

3.10 Pavement Life

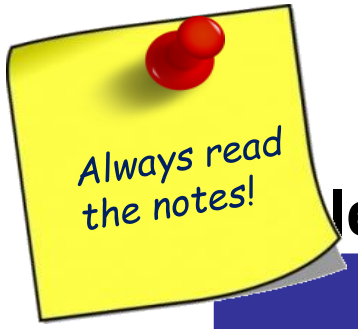
- **3.10.1** ***Design Life*** *in FAARFIELD refers to structural life, the total number of load cycles a pavement structure will carry before it fails structurally.*
- **3.10.2** ***Functional or useful life*** *is the period of time that the pavement is able to provide an acceptable level of service as measured by performance indicators such as FOD, skid resistance, or roughness. Pavements may have significant remaining functional life, even after they have failed structurally.*

Selection of Pavement Type

1.6.2

- **1.6.2.2** *The selection of a pavement section requires the evaluation of multiple factors including:*
  - *Cost and funding limitations*
  - *Operational Constraints*
  - *Construction timeframe*
  - *Material availability*
  - *Cost and frequency of anticipated maintenance*
  - *Environmental constraints*
  - *Future airport expansion plans*
  - *Anticipated changes in traffic*

Note: Analysis should consider multiple pavement sections, not just pavement types.



New Pavement Design

le 3-4. Minimum Layer Thickness for Rigid Pavement Structures[1]

Layer Type	FAA Specification Item	Maximum Aircraft Gross Weight Operating on Pavement, lbs		
		<60,000	< 100,000	≥ 100,000
Rigid Surface[2]	P-501	6 in^2	6 in^2	6 in^2
Drainable Base (When Used)	P-307 or P-407		6 in When used	6 in When used
Stabilized Base[3]	P-304, P-306, P-401, P-403	Not Required	Not Required	5 in
Base[4]	P-207, P-208, P-209, P-210, P-211, P-212, P-213, P-219, P-220	Not Required	6 in	6 in
Subbase[5]	P-154	6 in	As needed for frost or to create working platform	As needed for frost or to create working platform

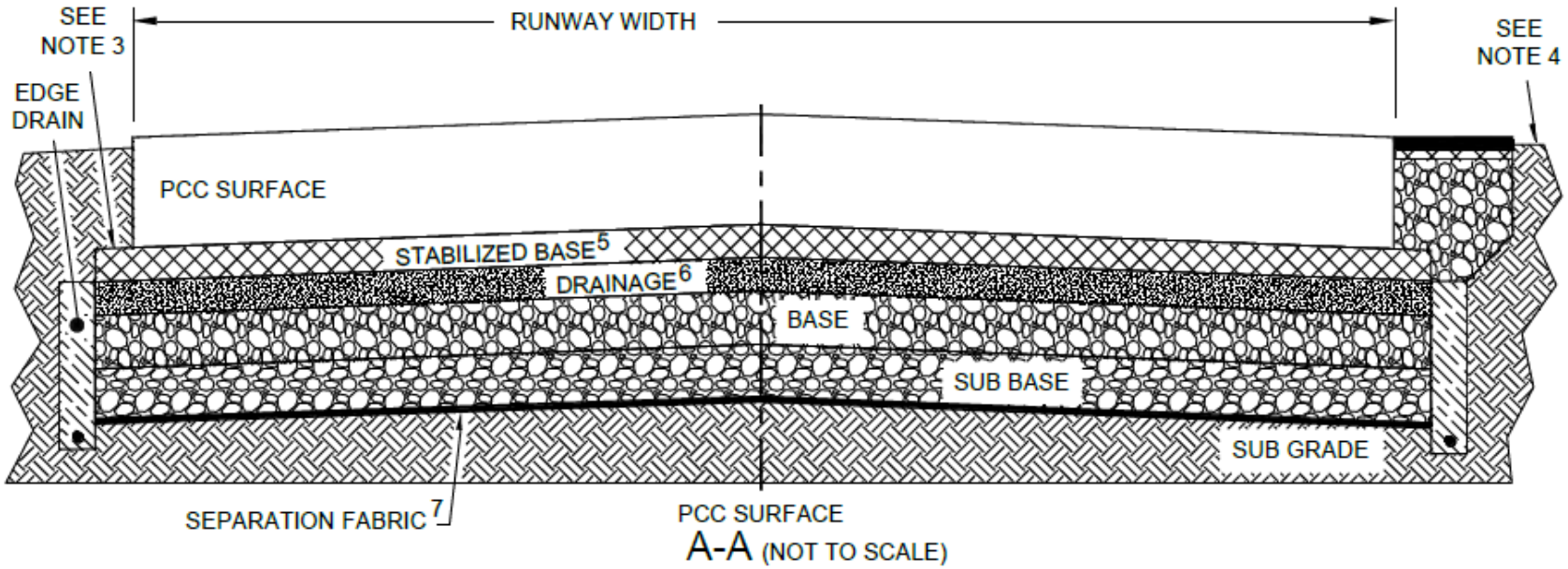
New Pavement Design

Table 3-4. Minimum Layer Thickness for Rigid Pavement Structures

Notes:

1. Complete structural design to determine rigid surface layer thickness required to support actual traffic.
2. Us greater of FAARFIELD thickness to the nearest 0.5 in, or minimum layer thickness. If all aircraft <30,000 lbs 5 in minimum thickness.
3. See paragraph 3.5, Stabilized Base Course, for requirements and limitations. P-220 may be used under concrete with minimum thickness of 12” and when concrete thickness is increased by 3”.
4. P-207, P-219 require laboratory testing to establish if it will perform as a base or subbase. If CBR > 80 may be used in place of P-209, CBR > 60 in place of P-208. Both may be used as a subbase under stabilized base.
5. Any base material may be used as a subbase.

Rigid Pavement Section

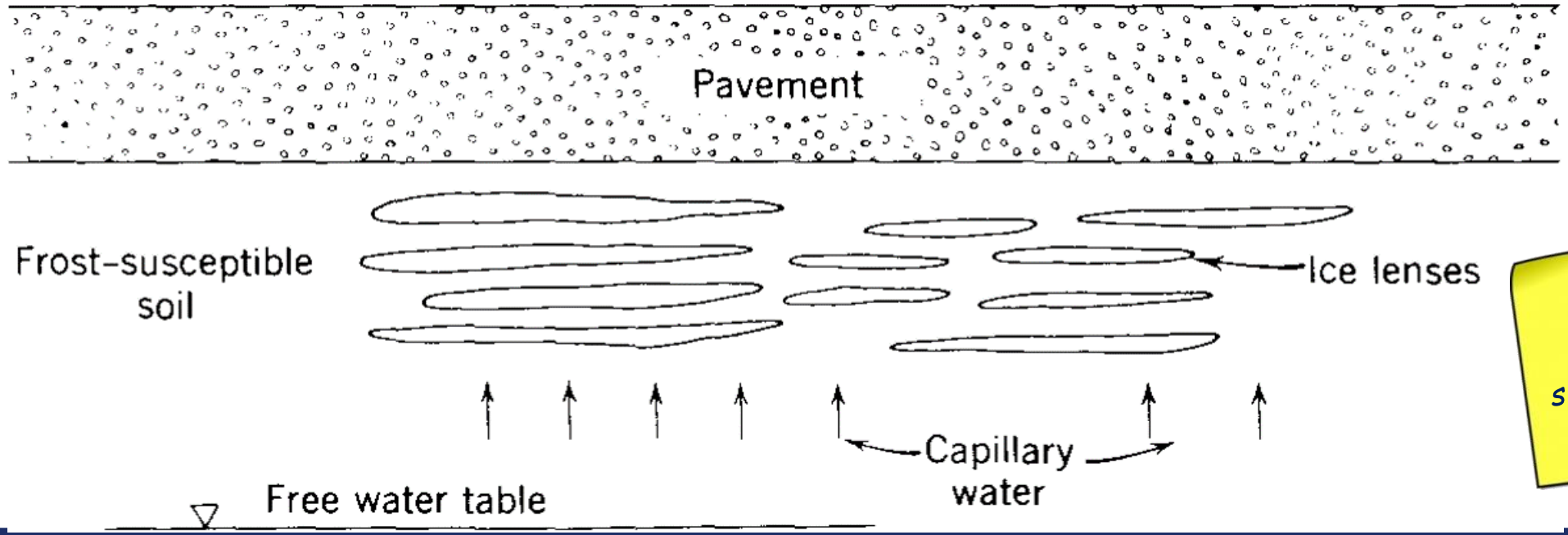


NOTES:

1. RUNWAY, TAXIWAY AND SHOULDER WIDTHS; TRANSVERSE SLOPES, ETC. PER AC 150/ 5300-13, AIRPORT DESIGN
2. SURFACE, BASE, PCC, ETC. THICKNESS PER AC 150/5320-6.
3. STABILIZED BASE, BASE AND SUBBASE MINIMUM 12 INCHES [30CM] UP TO 36 INCHES [90 CM] BEYOND FULL STRENGTH PAVEMENT.
4. CONSTRUCT A 1.5 INCH [4 CM] DROP BETWEEN PAVED AND UNPAVED SURFACES.
5. WHEN REQUIRED, SEE PARAGRAPH 3.5.
6. LOCATION AND NEED FOR DRAINAGE LAYER AS RECOMMENCED BY GEOTECHNICAL AND PAVEMENT ENGINEER.
7. WHEN RECOMMENDED BY GEOTECHNICAL AND PAVEMENT ENGINEER.

Design for Seasonal Frost

- **2.5 …***When all three conditions in paragraph 2.5.1 exist, support method of frost protection or why no frost protection is necessary in geotechnical report.*
- **2.5.1** *For detrimental frost action, three conditions are required:*
  1. *Frost susceptible soil,*
  2. *Freezing temperatures must penetrate into frost susceptible soils, and*
  3. *Free moisture must be available in sufficient quantity to form ice lenses.*



Are there signs of frost damage?

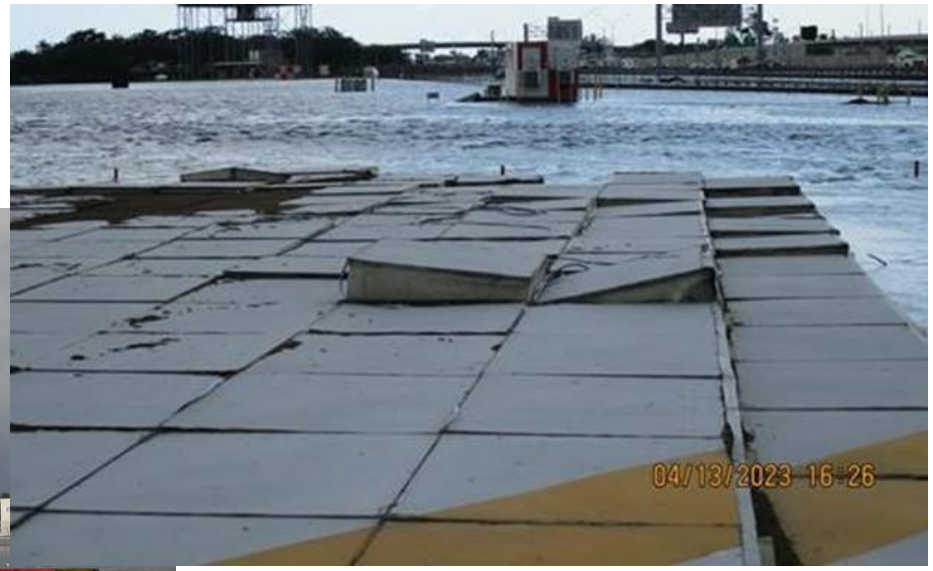
Design Alternative

- **Complete Frost Protection**
  - Remove frost susceptible materials to below frost depth
- **Limited Subgrade Frost Penetration**
  - Remove frost-susceptible material to a minimum of 65% of frost depth
  - Limits frost heave to acceptable level, typically less than 1 inch
- ***Reduced Subgrade Strength***
  - Reduce subgrade support value, typically about 50% of design strength
  - Design adequate load carrying capacity for weakened condition
  - Not allowed for FG-4 soils

Frost Group	Kind of Soil	Percentage Finer than 0.02 mm by Weight[3]	Soil Classification
FG-1	Gravelly Soils	3 to 10	GW, GP, GW-GM, GP-GM
FG-2	Gravelly Soils	10 to 20	GM, GW-GM, GP-GM
	Sands	3 to 15	SW, SP, SM, SW-SM, SP-SM
FG-3	Gravelly Soils	Over 20	GM, GC
	Sands, except very fine silty sands	Over 15	SM, SC
	Clays, PI above 12	-	CL, CH
FG-4	Very fine silty sands	Over 15	SM
	All Silts	-	ML, MH
	Clays, PI = 12 or less	-	CL, CL-ML
	Varved Clays and other fine-grained banded sediments	-	CL, CH, ML, SM

Drainage Layers – Should we consider?

Fort Lauderdale Airport (FLL) – 25.91 inches of rain in 24 hour period 4/12/23



Drainage Layers

Drainage Layers

- **3.7.1** *Drainage layers are recommended for pavements serving aircraft greater than 60,000 pounds, constructed in areas with excessive subsurface moisture and where existing soils have coefficient of permeability less than 20 ft/day.*

- **3.7.2** *The use of drainage layers will protect pavements from moisture related subgrade, subbase and base failures. Drainage layers facilitate the quick removal of excess moisture from pavement structure.*

- **3.7.3** *An effective drainage layer will attain 85 percent drainage in 24 hours for runways and taxiways, and 85 percent drainage in 10 days for aprons and other areas with low speed traffic. Drainage layers that provide a permeability of 500 – 1500 ft/day may be used without calculation.*

- **3.7.6** *For Rigid Pavements generally place a stabilized drainage layer immediately beneath the concrete panel in place of the stabilized base.*

Drainage Layers

Maintenance, Rehab and Reconstruction

4.2 Pavement Maintenance

- **4.2.1** *All pavements benefit from timely maintenance. Pavement with a PCI greater than 70 are candidates for some form of maintenance. It is always more cost effective to extend the life of a pavement in good condition than to rehabilitate or reconstruct a pavement in fair or poor condition.*

4.3 Rehabilitation

- **4.3.1** *Rehabilitation is defined as the replacement of a portion of the pavement structural layers. It is generally more cost effective to rehabilitate a pavement than to reconstruct it.*
- **4.3.2** *Pavements with a PCI less than 70 and greater than 55 are candidates for rehabilitation. There are times when a rehabilitation strategy is justified on pavements with PCI greater than 70 or less than 55.*
- **4.3.5** *Rehabilitation of rigid pavement may include repairing or replacing up to 30 percent of isolated panels. Rehabilitation of rigid pavement may also include asphalt or concrete overlays, or diamond grinding of the surface to restore the wearing surface.*

Maintenance, Rehab and Reconstruction

4.4 Reconstruction

- **4.4.1** *Reconstruction is the replacement of the main structural elements of the pavement.*
- **4.4.2** *The panel is the main structural element of a rigid pavement. Replacement of more than 30% of the panels is reconstruction.*
- **4.4.4** *Pavements that have a PCI less than 55 may be candidates for reconstruction. There are times when it is necessary to reconstruct a pavement with a PCI greater than 55. Similarly, there are times when a pavement with a PCI less than 55 can be rehabilitated with a flexible or rigid overlay, depending upon the nature of the distresses contributing to the PCI.*
- **4.4.5** *Partial reconstruction of just the areas that are severely distresses, e.g. in the center (keel) sections, may be a cost-effective alternative to total reconstruction.*

Why does the FAA define Maintenance vs. Rehabilitation vs. Reconstruction?

Maintenance, Rehab and Reconstruction

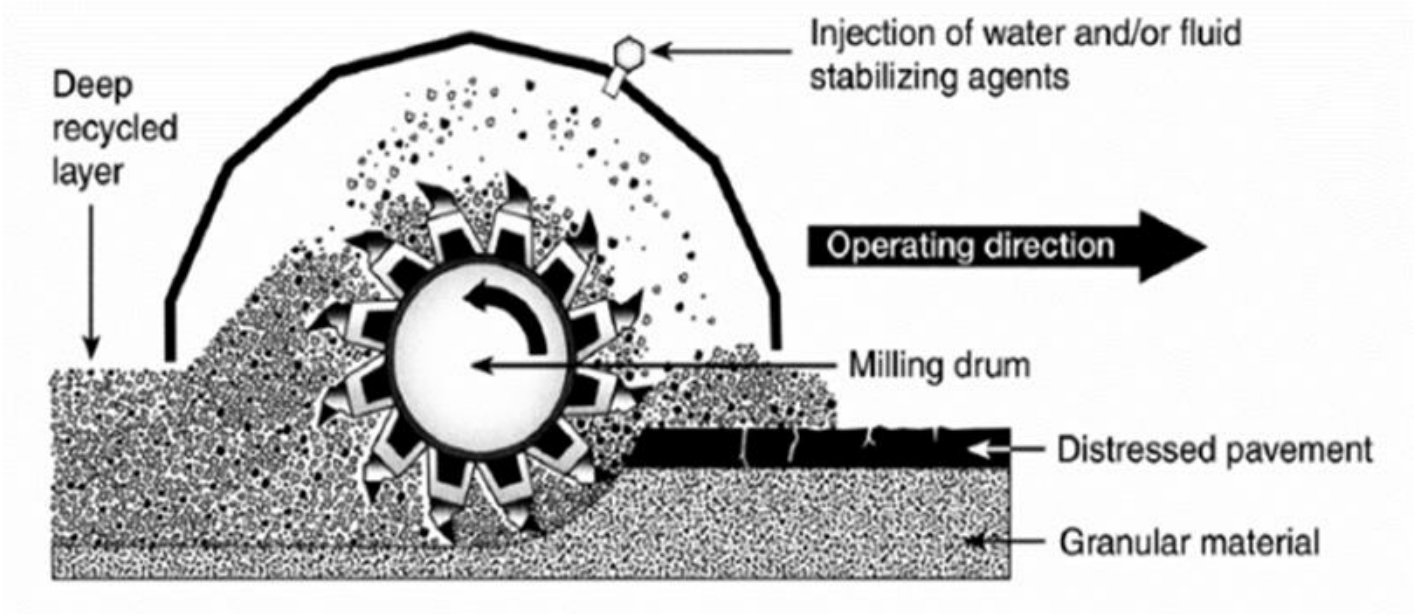
- **Maintenance:** Maintenance work is ineligible for FAA funding except at nonhub primary airports or nonprimary airports when properly justified.
  49 USC § 47102(3)(H)

- **Rehabilitation:** Rehabilitation projects are eligible for FAA funding, but typically pavement must be at least 10 years old.
  - When rehabilitating a pavement the project does not necessarily have to bring facility up to current FAA standards.

- **Reconstruction:** Reconstruction projects are eligible for FAA funding, but typically pavement must be at least 20 years old.
  - When reconstructing a pavement the facility must be brought up to current FAA standards (e.g. geometry, profile, RSA, imaginary surfaces)

Full-Depth Reclamation (FDR)

4.9.2.1 *Consists of pulverizing the full HMA pavement section prior to overlaying with either asphalt or concrete. Pulverization may include mixing in a stabilization agent, leveling, and compacting the reclaimed material layer into a uniform base layer prior to placement of additional structural layer(s).*



Full-Depth Reclamation (FDR)

4.9.2.2 *At non-primary general aviation airports, serving aircraft less than 30,000 pounds gross weight, it may be possible to place a surface layer of asphalt or concrete directly on the recycled base. However, at larger airports a crushed aggregate base and/or stabilized base may be required.*

4.9.2.4 *For the standard construction specification see AC 150/5370-10, Item P-207, Full Depth Reclamation (FDR) Recycled Aggregate Base Course.*

- *May modify gradation to fit in-place material (need geotech to confirm)*
- *Stabilization agents may improve strength of material*
- *Virgin aggregate may be blended in to control gradation and strength*

Rubblization of Existing Rigid Pavement

4.9.3.1 *The rubblization process eliminates the panel action by breaking the concrete panel into 1 to 3 inch pieces at the top and 3-to-15-inch pieces at the bottom. Rubblization is accomplished either through mechanical force (a pattern of hammer drops) or by using a resonant frequency breaker head.*

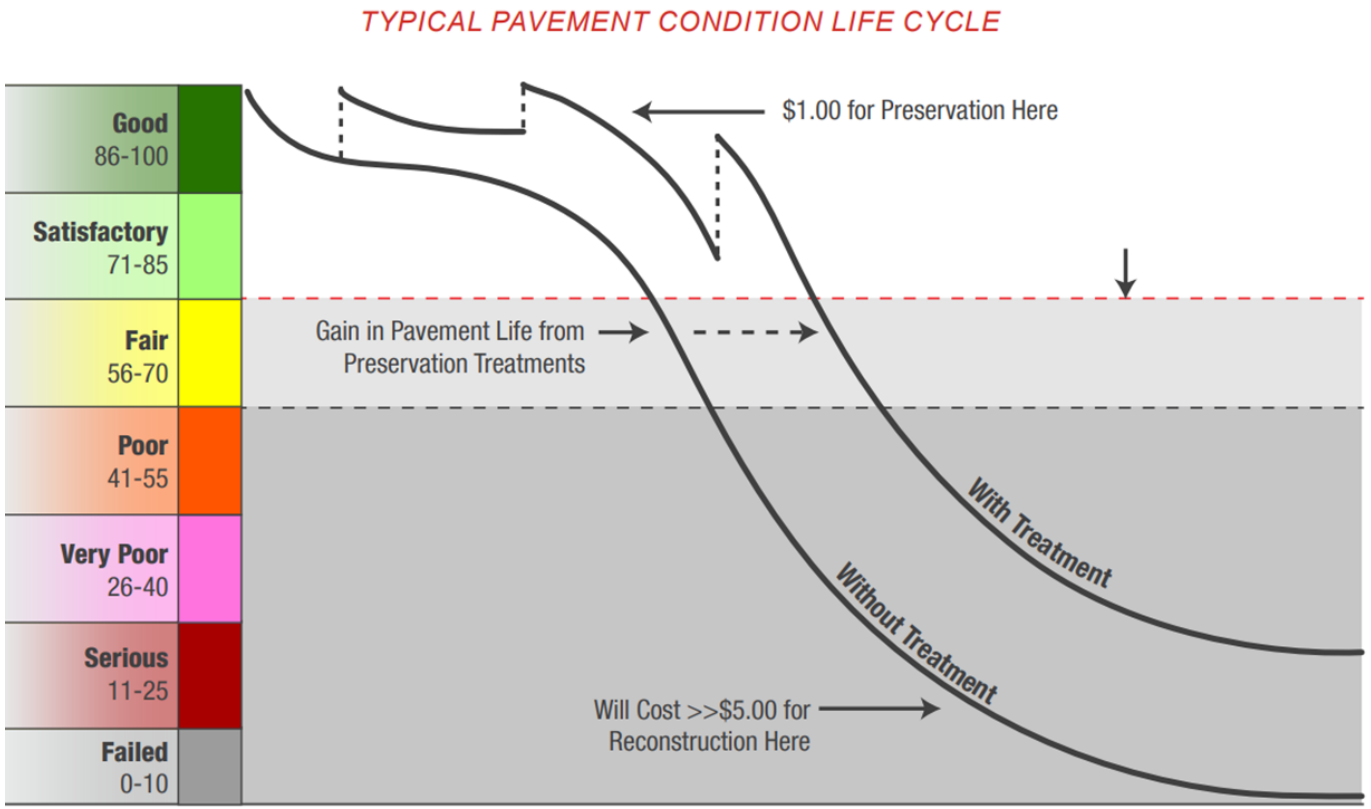
4.9.3.2 *The thickness design procedure for an overlay over a rubblized concrete base is similar to a new flexible or new rigid pavement design. Use EB-66 to develop design strength for input into FAARFIELD.*

EB-66 Rubblized Portland Cement Concrete Base Course

- Provides design recommendations for rubblization
- Includes P-215 as standard specification for rubblized concrete base course
- Requires MOS to use on a project
- Looking to add P-215 to AC 150/5370-10 in the next update

Pavement Management Program

- Required if have received AIP funds for pavement (since 1995)
- Responsibility of Airport/Owner
- PMP is more than Pavement Inspection
- FAA AC's
  - **150/5380-7B Airport Pavement Management Program (PMP)**
  - **150/5380-6C Guidelines and Procedures for Maintenance of Airport Pavements**



FAA Airports Safety & Standards
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