FAA Airport Pavement Design

AC 150/5320-6G

Presented to: ACPTP GA Concrete Workshop
Mankato, MN

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Federal Aviation Administration

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)**

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NPIAS Airports

Table 2: Activity and Development at NPIAS Airports

Airport Category	Number of Airports	Percentage of Airports	Percentage of Paved Runways	Percentage of 2021 Total Enplanements	Percentage of All Active GA Aircraft	Percentage of Total Operations	Percentage of NPIAS Cost
Large Hub	30	1	2	69	1	10	32.0
Medium Hub	35	1	2	18	2	5	14.9
Small Hub	80	2	4	9	5	7	9.7
Nonhub	238	7	9	3	10	10	12.2
Primary Subtotal	**383**	**11**	**17**	**99**	**18**	**32**	**68.8**
National	107	3	4		12	11	5.3
Regional	501	15	17		22	25	9.0
Local	1,179	36	34		20	23	10.3
Basic	904	28	23		3	7	6.0
Unclassified	213	7	5		1	2	0
Nonprimary Subtotal	**2,904**	**89**	**83**	**0.07**	**58**	**68**	**30.6**
Total NPIAS Airports	**3,287**	**100**	**100**	**100**	**76**	**100**	**100**

[1]Based on active general aviation fleet 204,380 aircraft in 2020. The remaining aircraft are based at other, non-NPIAS airports.

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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

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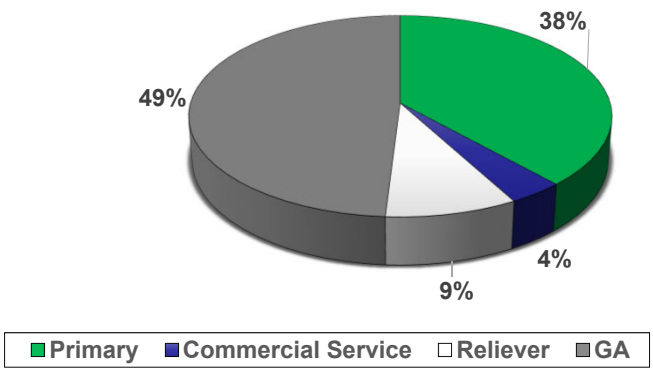
Runway Surface Area vs. Airport Category



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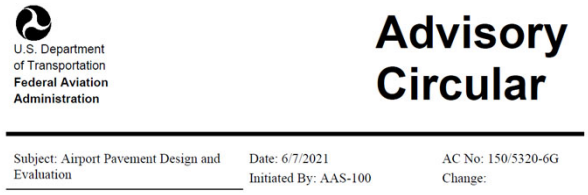
AC 150/5320-6G *Airport Pavement Design and Evaluation*

- **Released 6/7/2021**
- **Errata expected in 2023**
  - https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.information/documentID/1039843
- **FAARFIELD 2.0 Release with AC**
  - https://www.airporttech.tc.faa.gov/Products/Airport-Safety-Papers-Publications/Airport-Safety-Detail/ArtMID/3682/ArticleID/2841/FAARFIELD-20


U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

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

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Selection of Pavement Type

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.*

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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.

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New Pavement Design

Table 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

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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**

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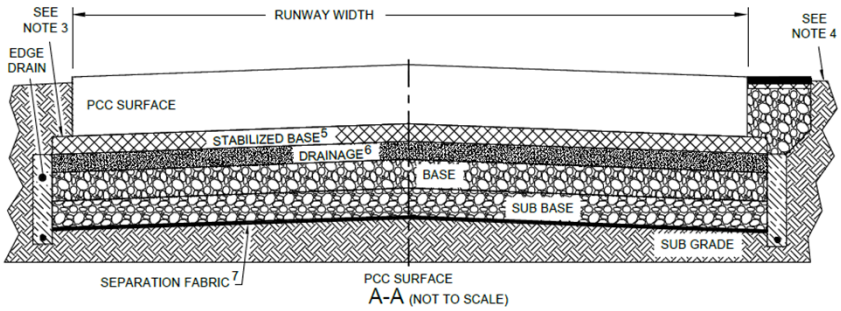
Typical Pavement Section



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.

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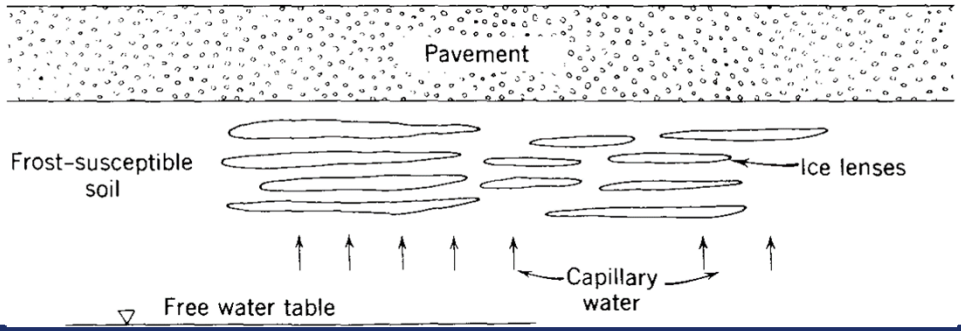
Design for Seasonal Frost

- **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.*



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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.*

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Drainage Layers

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Drainage Layers – Important for Resiliency?

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

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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)

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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).*

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

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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

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