Pavement Update
Track: Engineering

2017 ACC
Airports Technical Workshop

June 21-22, 2017
Arlington, VA

Gregory D. Cline, P.E.
FAA Airport Engineering AAS-100
gregory.cline@faa.gov
(202) 267-8814

Pavement Panel Presents :

- AC 150/5370-10, Standards for Specifying Construction of Airports: Updating to -10H
- AC 150/5320-6F, Airport Pavement Design and Evaluation
- PCN Requirements

  AC 150/5335-5C, Standardized Method of Reporting Airport Pavement Strength - PCN

Establishing or Changing Guidance

- HQ Office Initiates and Prepares Draft.
- Review by HQ Airports Offices and Regions.
- Revised Draft for Industry Review & Comment.
  - Posted to FAA Web Page
  - Sent by email
    - The Boeing Company and the Airports Consultants Council (ACC)
    - Tri-Service Airfield Pavement Working Group Team and ASCE T&DI APC
    - The Asphalt Institute (AI), National Asphalt Pavement Association (NAPA), and American Concrete Pavement Association (ACPA)
- Comments Accepted for ~ 3 weeks to 3 months.
- Change Finalized.
- FAA Legal Review, Office Director Signs.

What Delays a Change

- Non-Concurrence from HQ Offices.
- Non-Concurrence from FAA Regions.
- Inability to Reconcile Comments from Boeing, ACC, Peer Review Associations, or Industry.
- Substantive Alterations to a Proposed Change May Require New Draft.

Pavement Advisory Circulars

Advisory Circular			Title
AC 150/5370-10G	*	2014	Standards for Specifying Construction of Airports
AC 150/5320-6F		2016	Airport Pavement Design & Evaluation
AC 150/5335-5C	-	2014	Standardized Method of Reporting Airport Pavement Strength (PCN)
AC 150/5320-5D	-	2013	Surface Drainage Design
AC 150/5320-12C	*	1997	Measurement, Construction & Maintenance of Skid Resistant Airport Pavement Surfaces
AC 150/5370-11B	*	2011	Use of Non Destructive Testing in the Evaluation of Airport 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
AC 150/5370-12B (Combined 5370-12, 5370-6, 5300-9)		2015	Quality Management for Federally Funded Airport Construction Projects
AC 150/5100-13B	-	2011	Development of State Standards for Nonprimary Airports
AC 150/5000-15B		2013	Announcement of Availability of Airport-Related Research and Development Products

Pavement Computer Programs

Software	Description
FAARFIELD v 1.41	Airport Pavement Design
COMFAA 3.0	PCN/ACN
COMFAA 3.0 Support	Excel Spreadsheet to assist with PCN evaluation (development of reference section)
BAKFAA	Back-calculation of modulus from NDT testing
FAA PaveAir	FAA Pavement Management Software
PWL Spreadsheet	Asphaltic Concrete Payment Adjustments for Densities and Air Voids
Downloads	http://www.airporttech.tc.faa.gov/naptf/download/index1.asp#soft

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

AC 150/5370-10: Updating to H

- HQ Office Initiates and Prepares Draft.
- Review by HQ Airports Offices and Regions.
- Revised Draft for Industry Review & Comment.
  - Posted to FAA Web Page
  - Sent by email
    - The Boeing Company and the Airports Consultants Council (ACC)
    - Tri-Service Airfield Pavement Working Group Team and ASCE T&DI APC
    - The Asphalt Institute (AI), National Asphalt Pavement Association (NAPA), and American Concrete Pavement Association (ACPA)
- Comments Accepted for ~ 3 weeks to 3 months.
- Change Finalized.
- FAA Legal Review, Office Director Signs.

1st Q FY18 4th Q FY17

AC 150/5370-10: Updating to H

HQ Office Initiates and Prepares Draft

Mostly from Industry Feedback since current was posted

- Anything brought to our attention by Engineers, Industry, FAA, etc.
- Industry Meetings: Industry provides issues/concerns
  Industry provides specific draft wording if requested
  - NSSGA re. rock and aggregates; GMA for geosynthetics; ACPA for concrete pavement; AI for asphalt pavement; etc., as well as focused Industry interests such as for various surface treatments, precast concrete, markings, turf, etc.
- Comments from Engineers/others – anytime
  - When in the update process, we are in constant contact with various people in Industry to assist in thoughts and clarifications
  - Offered/encouraged when attendance of conferences and workshops sessions

For you in attendance here, today; not a colleague, or friend, or others

TIME is very short – June 30th

Specific issue, specific comment, specific recommendation

Complete review with comments during Industry Review

AC 150/5370-10: Updating to H

Short list of Principal changes

- **Extensive technical and editorial edits (no format change)**
- **Moved Section 100 Contractor Quality Control Program (CQCP) out of the General Provisions and re-number as "Item 100."**
  - Clarified requirements of the CQCP;
  - Added elements that must be addressed for pavement projects;
  - Added requirements for Contractor QC testing facilities for pavement projects (401, 403, 501, 601);
  - Added Basis of measurement and payment paragraph to allow for lump sum payment of CQCP
- **Moved Section 110 Method of Estimating Percentage of Materials Within Specification Limits (PWL) out of the General Provisions. Renumbered as "Item 110."**
  - Allows the Engineer to delete Item 110 when P-401, P-501 and/or P601 are not in a project.

AC 150/5370-10: Updating to H

Short list of Principal changes (Continued)

- Re-titled Item P-101 Surface Preparation to Item P-101 Preparation/Removal of Existing Pavements to better reflect purpose of specification.
- Item P-156, Temporary Air and Water Pollution, Soil Erosion, and Siltation Control has been renumber as Item P-102, Temporary Air and Water Pollution, Soil Erosion, and Siltation Control.
- Add new Item P-156, Cement Treated Subgrade. The requirements for cement treated subgrade were previously included in Item P-157.
- Item P-157 [Cement] [Lime] Kiln Dust (CKD) Treated Subgrade only addresses kiln dust.

AC 150/5370-10: Updating to H

Short list of Principal changes (Continued)

- Added use of the Asphalt Pavement Analyzer (APA) to Item P-401 eliminating the need to run stability and flow when using the Marshall Method. The same HMA design criteria in Table 1 is used for both the Marshall and Gyratory method.
- Swapped "Contractor Quality Control (CQC)" and "Material Acceptance" paragraphs in P-401, P-403, P-601, …..so the material acceptance and measurement/payment paragraphs are together.
- Separated Smoothness testing to appropriate areas in both P-401 and 501: Quality Control for daily testing and use of equipment other than Profilograph; and Quality Assurance for final smoothness using Profilograph; neither with pay deducts.

AC 150/5370-10: Updating to H

Short list of Principal changes (Continued)

- **Addition of several Items**
- **Numerous others**

Before we run out of time . . . . . .

AC 150/5320-6F
Airport Pavement Design and Evaluation

- Published and Posted 11/10/2016
- FAARFIELD V 1.41 (V 2.0 in 5320-6G)
- Updated Figures
- Consolidated Information on minimums
- Incorporate NDT as appendix

Typical Materials
(Refer to AC150/5370-10)

Pavement Layer	Flexible Pavement	Rigid Pavement
Surface Course	P-401/P-403[2]	P-501
Stabilized Base Course	P-401/403 P-304[3] P-306[3]	P-401/403 P-304[3] P-306[3]
Base Course	P-209[4] P-208[5] P-211	P-209[4] P-208[5] P-211
Subbase Course	P-154 P-213[6] P-219[7]	P-154 P-301[6] P-219[7]
Subgrade	P-152 P-155 P-157 P-158	P-152 P-155 P-157 P-158

Typical Materials

Lots of information in the footnotes

When substituting material consider what you need the material to do

Notes:

1. Refer to AC 150/5370-10, *Standards for Specifying Construction of Airports*, for the individual specifications.
2. P-601 may be used for locations that need a fuel resistant surface
3. P-304 and P-306 use with caution, susceptible to reflective cracking
4. P-209, Crushed Aggregate Base Course, used as a base course is limited to pavements designed for gross loads of 100,000 pounds (45 360 kg) or less.
5. P-208, Aggregate Base Course, used as base course is limited to pavements designed for gross loads of 60,000 pounds (27 200 kg) or less.
6. Use of P-213 and P-301 as subbase course is not recommended where frost penetration into the subbase is anticipated.
7. P-219, Recycled Concrete Aggregate Base Course, may be used as base depending on quality of materials and gradation.

Subgrade Support

2.1.3.2 → The design value for subgrade support should be conservatively selected to ensure a stable subgrade and should reflect the long term subgrade support that will be provided to the pavement. The FAA recommends selecting a value that is one standard deviation below the mean. Where the mean subgrade strength is lower than a California Bearing Ratio (CBR) of 5, it may be necessary to improve the subgrade through stabilization or other means in order to facilitate compaction of the subbase. When the design CBR is lower than 3, it is required to improve the subgrade through stabilization or other means. See paragraph 2.6.¶

CBR < 5 **Recommend** Improvement

CBR < 3 **Require** Improvement

Pavement Design

- **Design Guidance for Airfield Pavements**
  - All pavement designs require FAARFIELD
    no differentiation between light and aircraft > 30K
  - Tables of Minimum Layer Thickness by weight
- **Stabilized Base Course**
  - Full Scale Performance Tests prove that pavements with stabilized bases have superior performance
  - Exception: < 5% Traffic > 100K and < 110K

Minimum Thickness

Table 3-3. Minimum Layer Thickness for Flexible Pavement Structures

Layer Type	FAA Specification Item	Maximum Airplane Gross Weight Operating on Pavement, lbs (kg)		
		<12,500 (5 670)	< 100,000 (45 360)	≥100,000 (45 360)
HMA Surface[1, 2,3]	P-401, Hot Mix Asphalt (HMA) Pavements	3 in. (75 mm)	4 in. (100 mm)	4 in. (100 mm)
Stabilized Base	P-401 or P-403; P-304; P-306[4]	Not Required	Not Required	5 in. (125 mm)
Crushed Aggregate Base[5,6]	P-209, Crushed Aggregate Base Course	3 in. (75 mm)	6 in. (150 mm)	6 in. (150 mm)
Aggregate Base[5,7,8]	P-208,Aggregate Base Course	3 in. (75 mm)	Not Used[7]	Not Used
Subbase[5,8]	P-154, Subbase Course	4 in. (100 mm)	4 in. (100 mm) (If required)	4 in. (100 mm) (if required)

Minimum Thickness

Notes:

1. P-601-Fuel Resistant Hot Mix Asphalt may be used to replace the top 2 in (75 mm) of P-401 where a fuel resistant surface is needed; structurally, P-601 considered same as P-401.
2. Additional HMA surface above minimum typically in 0.5-inch (10-mm) increments.
3. P-403 may be used as surface course < 12,500 pounds (5,760 kg) or for HMA base or leveling course.
4. Use of P-306 requires FAA approval on federally funded projects to assure adequate measures taken to control potential for reflective cracking.
5. Use the larger of the thicknesses in this table or the thickness calculated by FAARFIELD rounded to the nearest 0.5 inch (10 mm). Additional thickness may be required for frost protection above minimums.
6. P-209, Crushed Aggregate Base Course, when used as a stabilized base course, is limited to pavements designed for gross loads of 100,000 pounds (45,360 kg) or less, except as noted in paragraph 3.6, Stabilized Base Course.
7. P-208, Aggregate Base Course, when used as a base course, is limited to pavements designed for gross loads of 60,000 pounds (27,220 kg) or less.
8. P-219 Recycled Concrete Aggregate Base Course may be used as an aggregate base or subbase. How P-219 will perform is related to the quality of the material it is made from combined with the method used to process it into an aggregate base.

Minimum Thickness

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

Layer Type	FAA Specification Item	Maximum Airplane Gross Weight Operating on Pavement, lbs (kg)		
		<12,500 (5,670)	< 100,000 (45,360)	≥ 100,000 (45,360)
PCC Surface	P-501, Portland Cement Concrete (PCC) Pavements	5 in. (125 mm)	6 in. (150 mm)[1]	6 in. (150 mm)[1]
Stabilized Base	P-401 or P-403; P-304; P-306	Not Required	Not Required	5 in. (125 mm)
Base	P-208, P-209, P-211, P-301	Not Required	6 in. (150 mm)[2]	6 in. (150 mm)
Subbase[3,4]	P-154, Subbase Course	4 in. (100 mm)	As needed for frost or to create working platform	As needed for frost or to create working platform

Notes:

1. FAARFIELD thickness to be rounded to the nearest 0.5 inch (10 mm).
2. For pavements for aircraft greater than 30,000 lbs (13,610 kg), base may be replaced with subbase.
3. Subbase layer is required for pavements designed for gross loads of 12,500 pounds (5,670 kg) or less only when the following soil types are present: OL, MH, CH, or OH.
4. The following specification items may also be used as subbase: P-208, Aggregate Base Course; P-209, Crushed Aggregate Base Course; P-211, Lime Rock Base Course; P-219 Recycled Concrete Aggregate Base Course; P-301, Soil-Cement Base Course. If more than one layer of subbase is used, each layer should meet the minimum thickness requirement in this table.

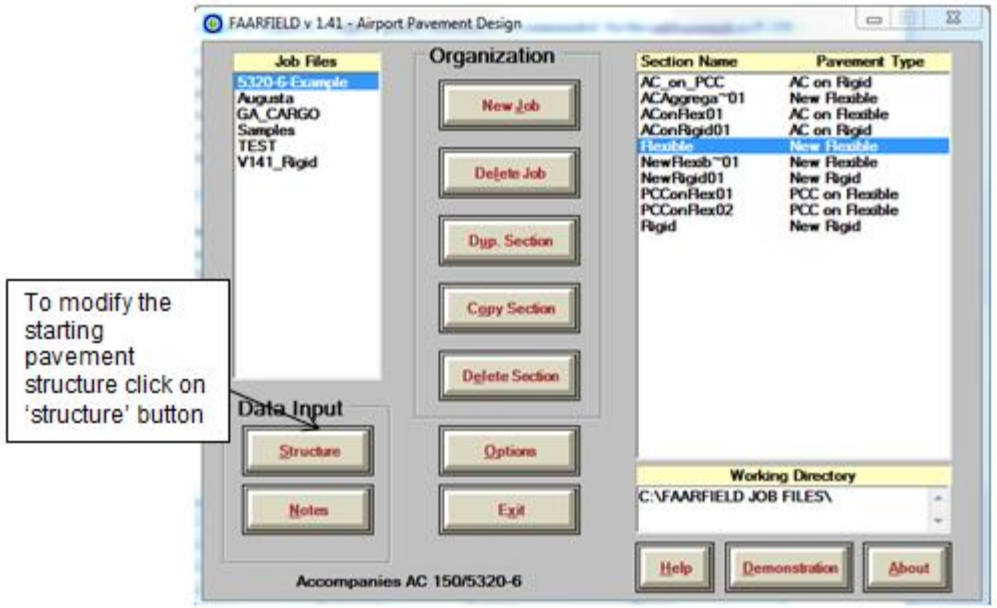
Traffic

- **In general design for ‘regularly’ using aircraft**
- **‘Regular’ use 250 annual departures (500 operations)**
- **Sensitivity analysis for occasional or seasonal**
  - Design Section
  - After adjusting structure for rounding and construction evaluate impact of all aircraft

Chapter 3 FAARFIELD EXAMPLES

- New examples
- Detailed step by step examples
  Flexible & Rigid Design

Figure 3-5. Flexible Design Example Step 1



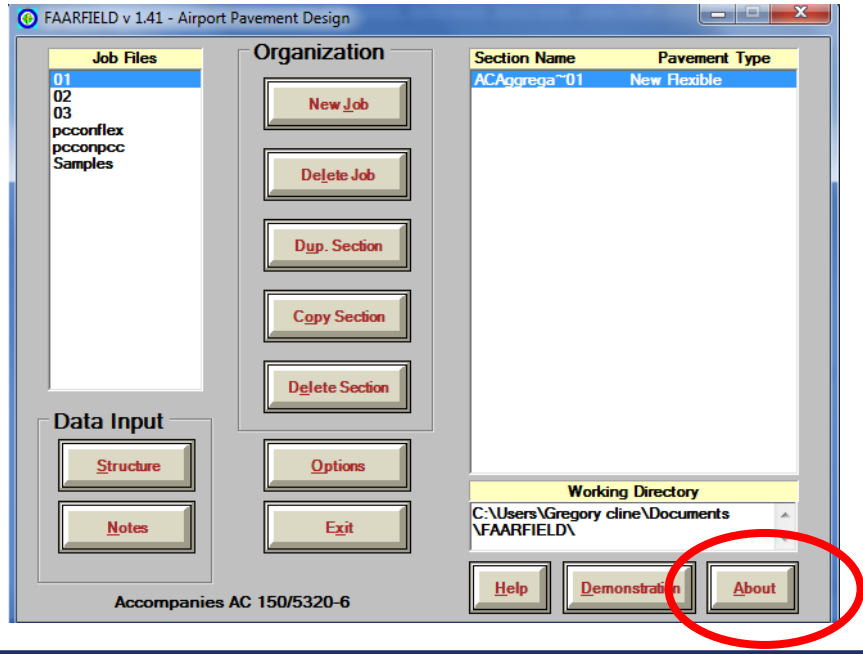
FAARFIELD 1.4

FAARFIELD UPDATES

- Minor changes/fixes occur
- i.e. most recent was in March – fixed automatic minimum thickness

- Most recent version
  1.41.0113

- What Version do I have?



Automated Compaction Criteria

Computes compaction control points for rigid & flexible pavements.

FAARFIELD v 1.41 - Notes and Information for Job REDAC

Section Names

- NewFlexible
- NewRigid

Design Information for Section NewRigid

Subgrade Compaction Requirements

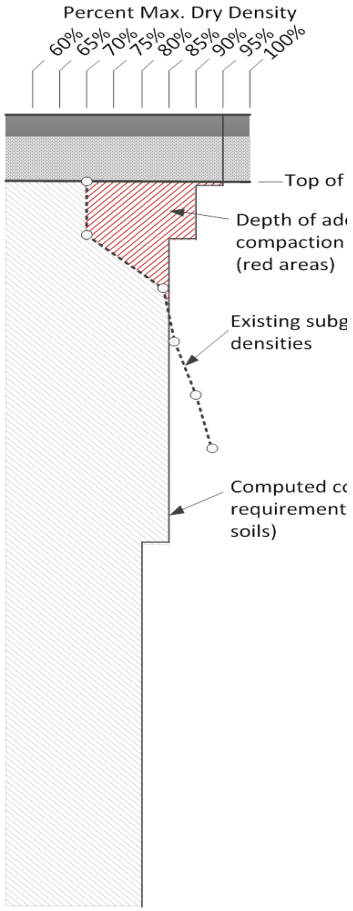
NonCohesive Soil

Percent Maximum Dry Density(%)	Depth of compaction from pavement surface (in)	Depth of compaction from top of subgrade (in)	Critical Airplane for Compaction
100	0 - 16	--	B777-200 ER
95	16 - 70	0 - 43	B777-200 ER
90	70 - 183	43 - 156	B747-200B Combi Mixed

Cohesive Soil

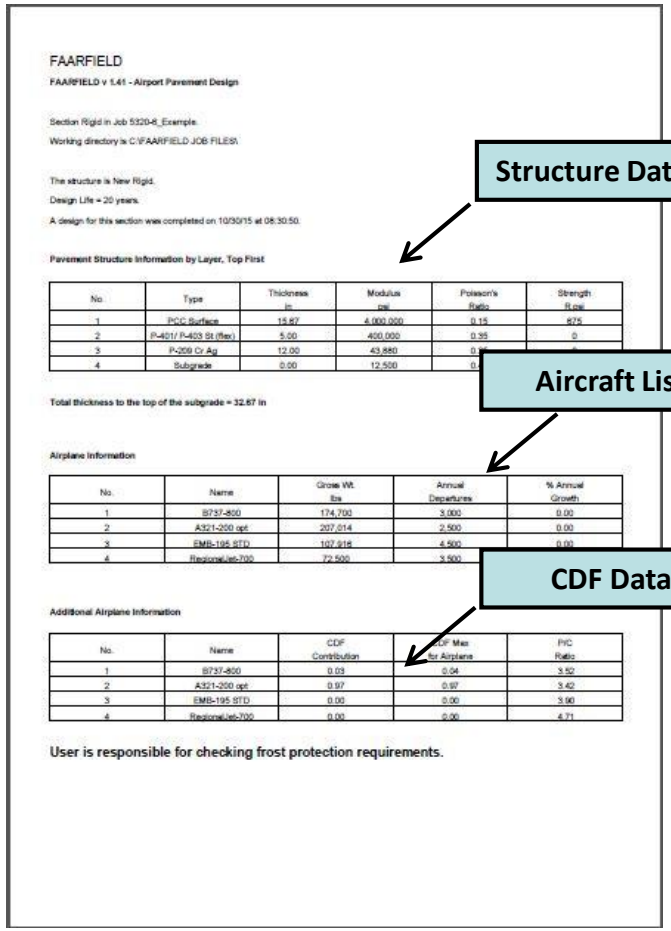
Percent Maximum Dry Density(%)	Depth of compaction from pavement surface (in)	Depth of compaction from top of subgrade (in)	Critical Airplane for Compaction
95	0 - 16	--	B777-200 ER
90	16 - 28	0 - 1	B777-200 ER
85	28 - 96	1 - 69	B747-200B Combi Mixed
80	96 - 178	69 - 151	B747-200B Combi Mixed

Help | Back | Save XML | Save | Print | Design Info | Notes | Copy



Design Report Automatically Saved as PDF to working directory

File Name: *JobName_SectionName*.pdf



FAARFIELD

FAARFIELD v 1.41 - Airport Pavement Design

Section Rigid in Job 5320-6_Example.

Working directory is C:\FAARFIELD JOB FILES\

The structure is New Rigid.

Design Life = 20 years.

A design for this section was completed on 10/30/15 at 08:30:50.

Structure Data

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R psi
1	PCC Surface	15.67	4,000,000	0.15	675
2	P-401/ P-403 St (flex)	5.00	400,000	0.35	0
3	P-209 Cr Ag	12.00	43,880	0.35	0
4	Subgrade	0.00	12,500	0.35	0

Total thickness to the top of the subgrade = 32.67 in

Aircraft List

Airplane Information

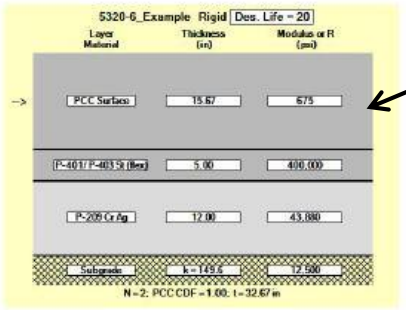
No.	Name	Gross Wt lbs	Annual Departures	% Annual Growth
1	B737-800	174,700	3,000	0.00
2	A321-200 opt	207,014	2,500	0.00
3	EMB-195 STD	107,916	4,500	0.00
4	RegionalJet-700	72,500	3,500	0.00

CDF Data

Additional Airplane Information

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	B737-800	0.03	0.04	3.52
2	A321-200 opt	0.97	0.97	3.42
3	EMB-195 STD	0.00	0.00	3.90
4	RegionalJet-700	0.00	0.00	4.71

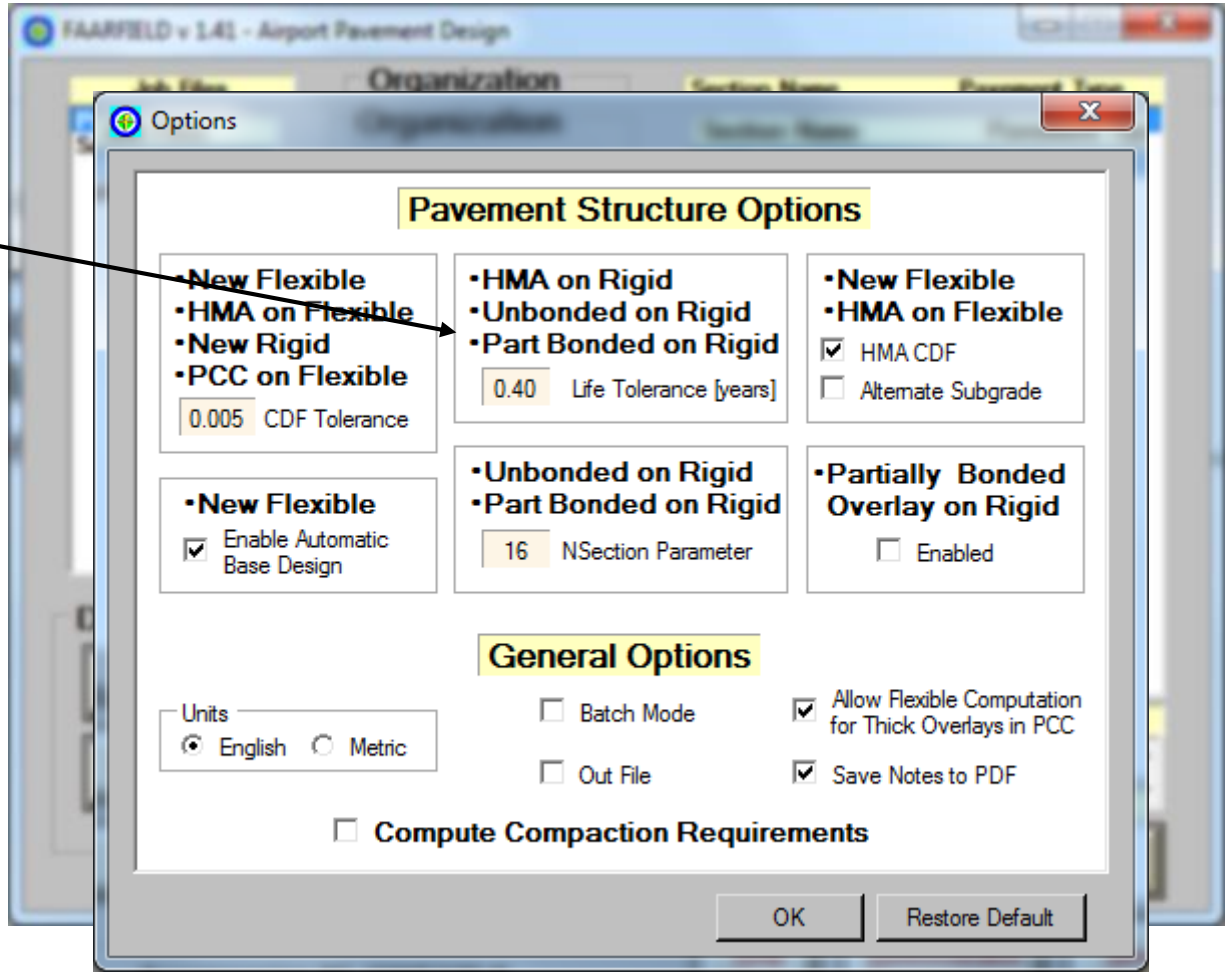
User is responsible for checking frost protection requirements.



Designed Pavement Section

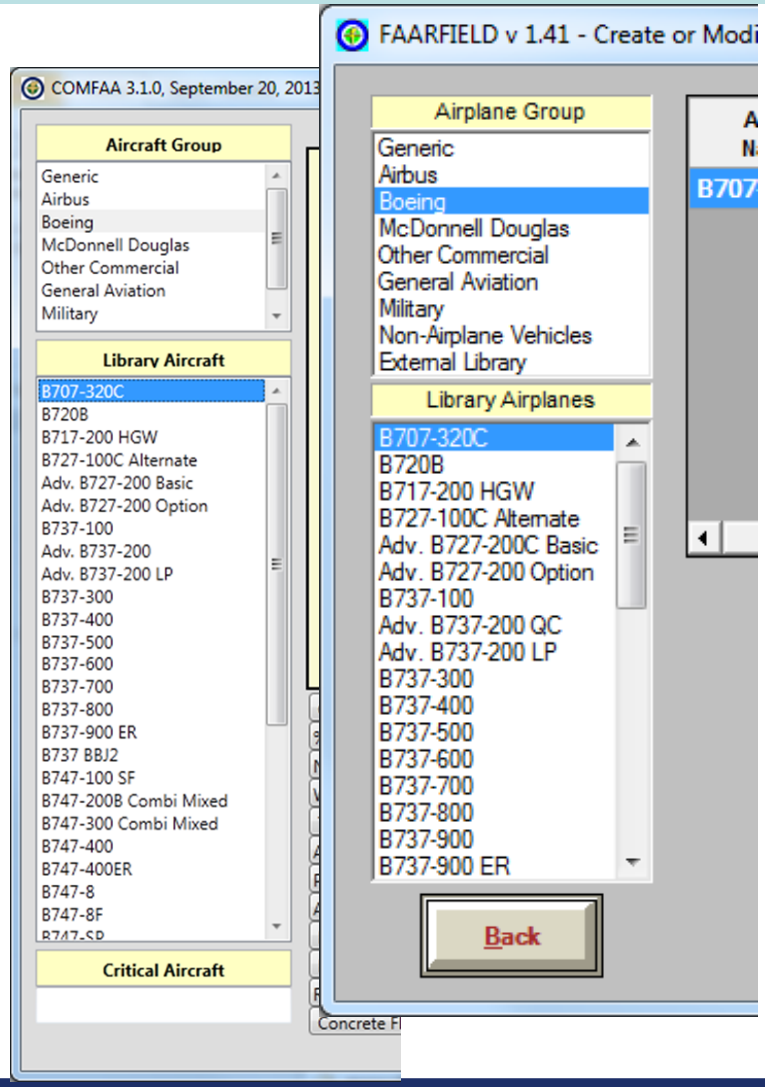
Pavement Structure Options

CDF tolerances, life tolerances may be adjusted;
Many of these options are for research or other analysis, if in doubt leave at the default value.



Aircraft Libraries

- **FAARFIELD & COMFAA aircraft libraries aligned to the extent possible.**
- **All Multigear AC split into main & belly, but linked for weight & activity**
- **Included new aircraft:**
  - A350-900 (Preliminary)
  - B747-8
  - B787-9
  - Embraer Fleet



Passenger Loading Bridge

- **Solid Tires with very high contact pressure**
- **Loads on bridges significant**
- **Consider rigid pavement where bridge operates**

3.18 → **Passenger Loading Bridge.**¶

Design of the passenger loading bridge operating area is separate from the design of the adjacent aircraft apron. Loads of passenger loading bridges range from 40,000 – 100,000 pounds supported on two solid tires resulting in loads ranging from 600-700 psi per tire. Due to the large range of potential loads verify the actual loads and contact tire pressure with the manufacturer of the passenger loading bridge. The FAA recommends rigid pavement be used where the passenger loading bridge will operate. Drainage structures and fuel hydrants should not be located in the jet bridge operation area. The design of the adjacent aircraft parking apron should only consider the aircraft and any equipment that will use the apron and not the load of the passenger loading bridge.

Overlay Design

- **Reason for Rehabilitation**
  - Why is pavement ready for rehabilitation
  - Structural, material distress, other
- **Start with condition assessment**
  - Complete assessment of pavement materials and structural integrity
  - Thickness, condition, nature and strength of each layer
- **Design must correct reason for rehabilitation**

Pavement Design for Shoulders

- **Paved shoulders**
  - Required for Aircraft Group IV and higher
  - Recommended Aircraft Group III
- **Stabilized Shoulders**
  - Recommended Aircraft Group I & II
  - (Turf, aggregate-turf, soil cement, lime or bituminous stabilized soil)
- **Most Demanding of**
  - 15 Passes of most demanding airplane or anticipated traffic from maintenance vehicles

Pavement Design for Shoulders

Table 6-1. Minimum Shoulder Pavement Layer Thickness

Layer Type	FAA Specification Item	Minimum Thickness, in (mm)
HMA Surface	P-401, P-403	4.0 (100)
PCC Surface	P-501	6.0 (150)
Aggregate Base Course	P-209, P-208,	6.0 (150)1
Subbase (if needed)	P-154	4.0 (100)

Note:

1. Minimum thickness of aggregate base

PCN Requirements

ICAO and FAA (AC 150/5335-5C)

Applies only to pavements with bearing strengths of 12,500 pounds (5,700 kg) or greater.

ALL runways at ALL Commercial Service Airports to have been completed by now.

Can be determined Technically or by Use

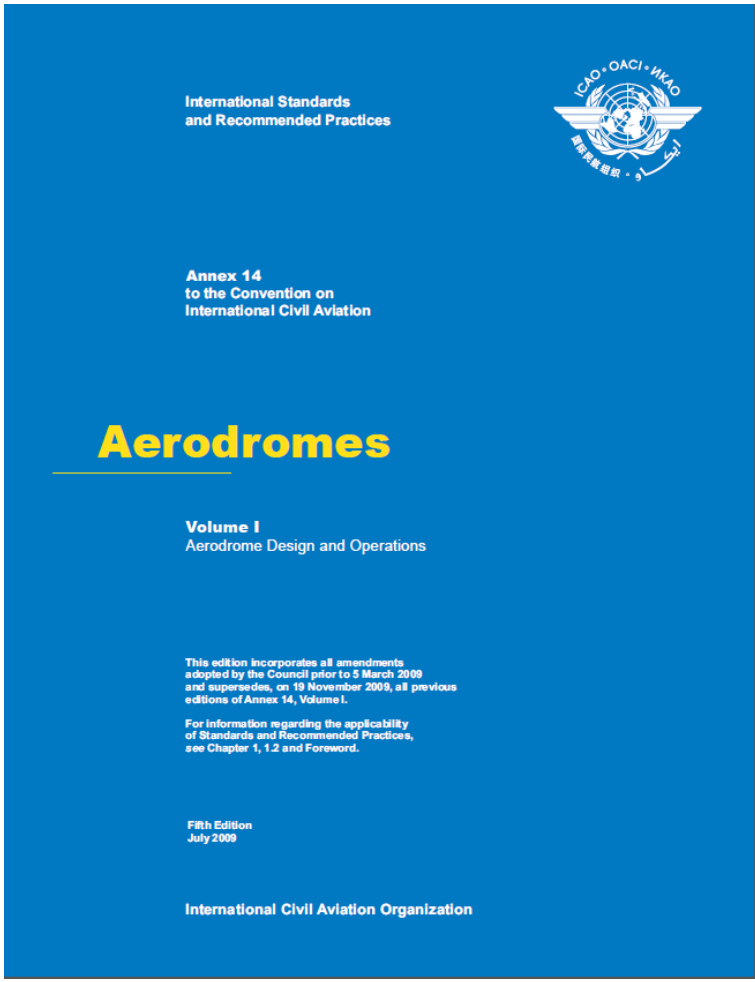
Reported by Airport Owner

Reported on 5010

Why: ACN/PCN

The ACN/PCN method is an ICAO Standard.

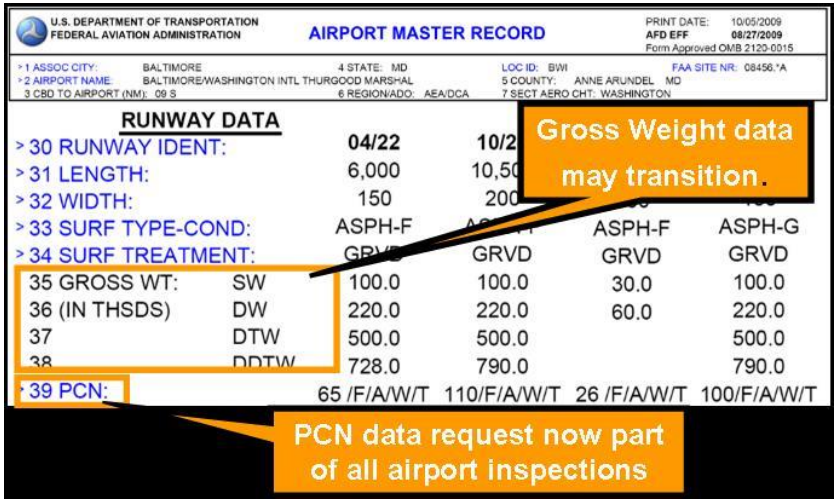
PCN reporting is required by international treaty for member states.



Why is the FAA Requiring U.S. Airports to Report PCN?

- The ACN-PCN method is an ICAO standard. PCN reporting by member states is required under international treaty.
- The FAA is responsible for certifying all commercial airports in the U.S.
- At this time, the Aircraft Gross Weight fields (elements 35 – 38) have been retained on Form 5010.

Airport Master Record (Form 5010)



ACN-PCN Application

- Applies only to pavements with bearing strengths of 12,500 pounds (5,700 kg) or greater.

- **< 12,500 pounds still report weights based upon gear type (technically per ICAO < 12,500 gross wt + tire pressure)**

ACN / PCN Who Reports

- **ACN reported by Aircraft Manufacture**
- **PCN reported by Airport Owner / Operator**
  - Easily done in conjunction with Pavement Condition Index (PCI) Survey (@ 3 YR)
  - AIP Eligible under Planning Grant Or AIP Pavement Construction Project

PCN Reporting Format

- **PCN values are reported in a coded format using 5 parts separated by "/"**

  Sample 39/F/B/X/T

- **Information includes:**
  - Numerical PCN Value (39 in this example)
  - Pavement Type (F = Flexible, R = Rigid)
  - Subgrade Strength Category (A, B, C or D)
  - Allowable Tire Pressure (X $\leq$ 1.5 MPa = 218 psi)
  - PCN Evaluation Method (U = Using aircraft method, T = Technical)

PCN Data Reported on 5010

- **Reporting PCN and associated maximum gross weights on 5010 is not subject to NEPA**
- **NEPA Trigger is approval of the ALP itself**
  - If required, NEPA action would have occurred prior to programing of project
- **Approaches to airports based upon AAC/ADG**
  - Verify that aircraft used to determine PCN within same Aircraft Approach Category (AAC) or Airplane Design Group (ADG) as on approved ALP for that RW.

Thank You

Questions / Discussion

Gregory D. Cline, P.E.

Gregory.cline@faa.gov

(202) 267-8814

Doug Johnson, P.E.

Doug.johnson@faa.gov

(202) 267-4689