ACR/PCR Overview

Aircraft Classification Rating/ Pavement Classification Rating

Presented to: REDAC Subcommittee on Airports By: David R. Brill, Ph.D. Date: March 4, 2020



What's Coming – **Preview of the ACR-PCR System**

- Developed in cooperation with ICAO Aerodromes Pavement Expert Group (APEG).
 - Designated ACR-PCR (Aircraft Classification Rating Pavement Classification Rating) System
 - Participants included the major aircraft manufacturers, ACI World, FAA and DGAC-France.

• Same concepts as current ACN-PCN method, but:

- Fully layered elastic-based.
- Uses uniform standard subgrade categories for flexible and rigid.
- NO alpha factor, layer equivalency factors, top-of-base *k*, etc.
- FAA developed program ICAO-ACR.
 - Visual Basic class library computes rigid & flexible ACRs.
 - Replacement for legacy ICAO ACN computer programs.
 - Open source library supports linking to any PCN program.



ACR-PCR Current Status

- Proposed amendment to Annex 14 on ACR-PCR has gone through State review with no objections.
- After formal adoption by the ICAO Air Navigation Committee (ANC), there will be a four-year transition period from ACN-PCN to ACR-PCR:
 - Effective date July 2020.
 - Full applicability November 2024.
 - During transition, both systems will remain available.
- An updated ADM Part 3 with the new procedures will be posted in the near future.
- Training on ACR-PCR is planned.



ICAO-ACR Computer Program

• Availability:

- Maintained by FAA.
- Download free of charge: <u>https://www.airporttech.tc.faa.gov</u> <u>/Products/Airport-Pavement-</u> <u>Software-Programs</u>
- Ability to link directly to other applications that:
 - Compute ACR (e.g., for aircraft gear design).
 - Use the standard ACR computation to evaluate PCR.
- Procedures for linking to ICAO-ACR will be given in an appendix to the ADM update.

🖷 ICAO-ACR Version 1.25 Date February 20, 2019 X Input Data Boeing Flexible Select Airplane Group Pavement Type O Rigid Select Airplane B777-200 Baseline 547,000 Gross Weight (bs) 0 954 Percent GW Calculate ACR * Number of Wheels 12 182.00 Tire Pressure (psi) Display Select Wheels (SW) Metric Wheel Coordinates (in) No Х Subgrade Subgrade Modulus Flexible ACR Thickness t ACR Number Category psi [in] -243.50 -57.00 653.16 D 7 251 89 34 04 -188.50 -57.00 2 С 11.603.02 466.00 25.34 -243.50 3 0.00 В 17.404.53 415.73 21.18 4 -188.50 0.00 А 29,007.55 391.07 16.36 5 -243.50 57.00 Calculation time: 2.66 sec Input Data - Gear

ICAO-ACR version 1.25 GUI





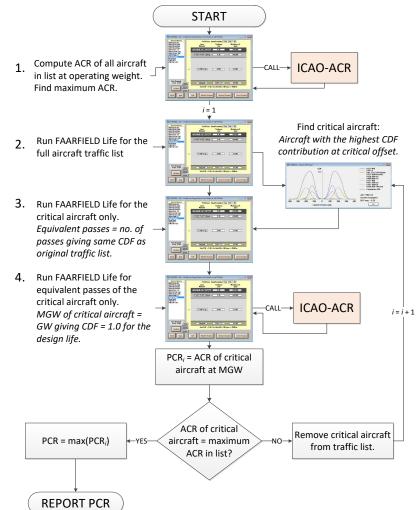
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Flowchart of PCR Calculation

- Directly uses FAARFIELD structure and traffic list.
- Planned replacement for COMFAA 3.0 & support spreadsheets.
- Method yields uniquely defined PCR.
 - No more considering multiple potential PCRs for different critical aircraft.

Implemented in FAARFIELD 2.0

- Solves problem of computing PCR for mixed traffic (narrow bodies and LR aircraft) without unnecessary operating weight restrictions.
- Seamlessly handles HMA overlays on flexible pavements.





FAARFIELD 2.0 PCR Implementation

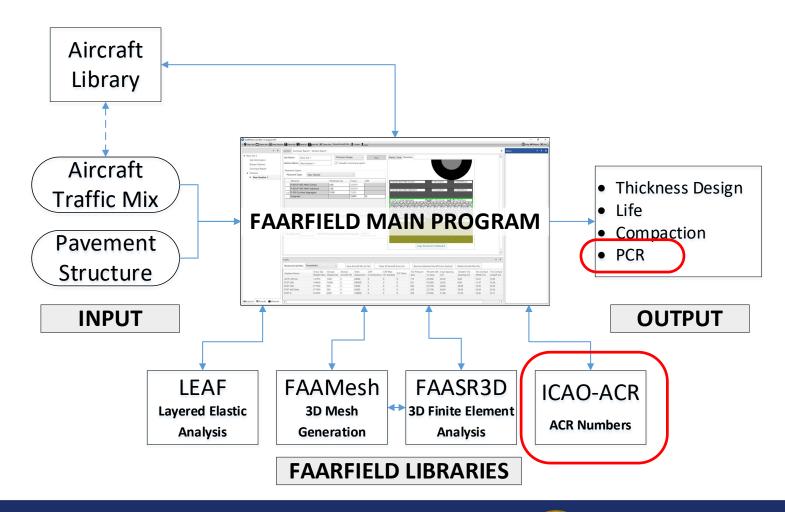
- Replacement for current FAARFIELD 1.42
 - Release software with next update of AC 150/5320-6.
 - Currently in beta test.
 - New: Features support for ACR-PCR.
 - Will replace COMFAA as primary pavement strength reporting software in next update of AC 150/5335-5.

FAARFIELD PCR integration

- Shared aircraft library.
- Use FAARFIELD pavement structure and aircraft list directly.
- No support spreadsheets required.
- Built-in 5010 report generation.
- Much better compatibility with FAARFIELD thickness designs.



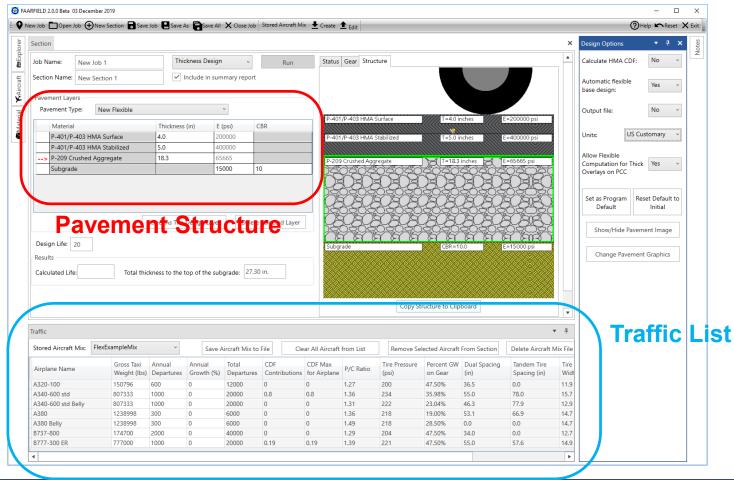
FAARFIELD 2.0 PCR Integration



March 4, 2020



Completed Design:



March 4, 2020



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PCR Graph

- Critical aircraft is A340-600.
- All using aircraft ACR are < PCR.
- PCR is consistent with

FAARFIELD 2.0.0 Beta 03 December 2019 FAARFIELD 2.0 thickness design. 🕈 New Job 🗖 Open Job 🕀 New Section 🖥 Save Job 🖪 Save As 🖨 Save All 🗙 Close Job Stored Aircraft Mix 🛨 P Section PCR Graph Calculate HMA CDF: No Save As PDF ĕ craft Federal Aviation Administration FAARFIELD 2.0 PCR Graph Automatic flexible Yes base design ¥ Version 2.0 Build (11/06/2019) No Output file: Material Working directory is C:\Users\David Brill\Documents\My FAARFIELD Job Name: New Job 1 US Customary Units: Section: New Section 1 Allow Flexible Computation for Thick Yes Analysis Type: New Flexible Overlays on PCC A320-100 A340-600 std A380 B737-800 B777-300 ER Aircraft ACR (Blue Square Bar) 337.8 644.5 578.3 410.1 629.2 Set as Program Reset Default to Calculated PCR (Black Line) 703.9 Default Initial Annual Departure (Red Line) 600 1000 300 2000 1000 Show/Hide Pavement Image 800-2500 2000 Change Pavement Graphics 600-ACR /PCR ā 1500 Dep 400 1000 200 a 500 A320-100 B737-800 A380 B777-300 EB A340-600 std Aircraft ACR - Calculated PCR - Annual Departures Traffic

March 4, 2020



Thank you!

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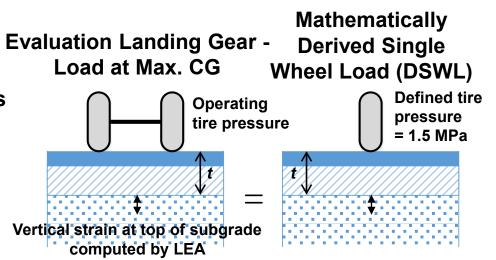
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ACR Methodology – Principles

Similar to ACN, except:

- All structures are layered elastic (rigid and flexible).
- Retains 4 standard subgrade categories, but defined by modulus (*E*) not CBR or *k*.
- Flexible ACR considers <u>all</u> wheels in the main landing gear.
- Standard tire pressure increased to 1.5 MPa.
- Standard coverages increased to 36,500 for flexible ACR.
- DSWL expressed in 100's (not 1000's) of kg.
- For most aircraft, ACR numerical values are <u>approximately</u> 10X higher than equivalent ACN.



The ACR numerical value is defined as two times the DSWL (expressed in <u>hundreds</u> of kilograms)

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ACR-PCR Subgrade Categories

Category	A	В	С	D
Strength	High	Medium	Low	Ultra-Low
<i>E</i> Value, MPa	200	120	80	50
Range, MPa	<i>E</i> ≥ 150	$150 > E \ge 100$	$100 > E \ge 60$	60 > E

- Categories are defined by *E*, not CBR or *k*.
- Same categories for rigid and flexible pavements.
- All values defined at top of subgrade.

