International Civil Aviation Organization

Ninth Meeting of the Aerodromes Operations and Planning Sub-Group (AOP/SG/9)

Bangkok, Thailand, 30 June to 4 July 2025

Agenda Item 5: State's/Aerodrome Operator's update and best practice on:

- **ACR- PCR Method of Reporting Aerodrome Pavement Bearing Strength**

IMPLEMENTATION OF NEW PAVEMENT RATING SYSTEM ACR-PCR AT CERTIFIED AIRPORTS

(Presented by Pakistan)

SUMMARY

This paper highlights the implementation of a new pavement rating system i.e. ACR-PCR at certified aerodromes which has become applicable from 28th November 2024. In connection, Pakistan has adopted the method "**using aircraft experience**" in transition period, and updated data in Aeronautical Information Publication of Pakistan section AD 2.8 and 2.12. The paper highlights the limitations of adopting "**using aircraft experience**" method. In order to better utilize the new ACR-PCR method, future plan for adoption of "technical evaluation" method is also discussed in the paper.

1. INTRODUCTION

1.1 The new pavement rating system (ACR-PCR) was first adopted in amendment 15 of ICAO Annex-14 (Vol-1) with effective date of 20th July 2020 and applicability date of 28th November 2024. The new rating system has replaced the existing strength rating ACN-PCN system and aerodrome operators have to comply with the new changes and publish relevant data in AIP and other documents i.e. Aerodrome manual, guidance materials, SOPs, etc. The ACR-PCR method was finalized by the Aerodrome Pavement Expert Group (APEG) beginning of 2018, followed by the full ICAO review and adoption process which become effective since July, 2020 with applicable date of 28th November 2024. The key characteristics of the ACR-PCR system are given below as similar to ACN, except:

i. All structures are layered elastic (rigid and flexible).

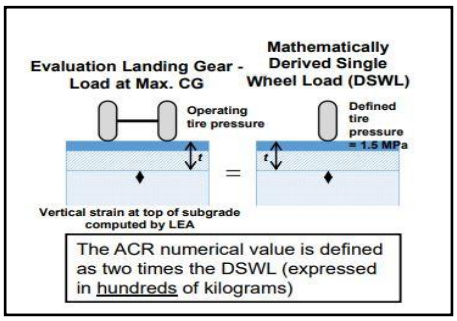
ii. Retains four (4) standard subgrade categories, but defined by modulus (E) not CBR or k.

iii. Flexible ACR considers all wheels in the main landing gear.

iv. Standard tire pressure 1.5 MPa. (218 psi)

v. Standard coverages increased to 36,500 for flexible ACR.

vi. DSWL expressed in 100's (not 1000's) of kg. ACR numerical values are approximately 10X higher than equivalent ACN.



ACR-PCR Subgrade Categories

Category	A	B	C	D
Strength	High	Medium	Low	Ultra-Low
E Value, MPa	200	120	80	50
Range, MPa	$E \geq 150$	$150 > E \geq 100$	$100 > E \geq 60$	$60 > E$

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

ACR-PCR Tire Pressure Categories

Category	Code	Tire Pressure Range
Unlimited	W	No pressure limit
High	X	Up to 1.75 MPa (254 psi)
Medium	Y	Up to 1.25 MPa (181 psi)
Low	Z	Up to 0.5 MPa (73 psi)

1.2 The need for an improved "rational" pavement rating system has been recognized for decades. The old ACN-PCN method was based on simplified methods originally developed in the late 1930s and 1940s: – Flexible pavements: CBR design procedure based on Boussinesq's theory – Rigid pavements: PCA design procedure based on Westergaard's theory. These methods have well-known deficiencies: due to its inability to consider accurately "complex" landing gear configurations in the modern and future aircrafts, unable to account for the improved characteristics of new-generation pavement materials, inconsistent with modern pavement design methods and unable to consider the variability of landing gear transverse positions (different overall wheel tracks). Furthermore, incompatibility between design methods and ACN/PCN leads to illogical results. On the contrary; ACR-PCR system has potential benefits in terms of "**optimized usage of airport pavements**" as compared to using more conservative empirical methods. This method will benefit both airline and airport operators in terms of "financial gains" and more robust pavement operations.

1.3 A Pavement Rating System Classifies the pavements with regard to their structural capacity of sustaining a forecasted aircraft mix based on two elements associated to the PAVEMENT and the AIRCRAFT. What DOES NOT change is the comparison of ACR and PCR as the core principle of the method: If ACR ≤ PCR, the aircraft can operate on the pavement without restriction. If ACN > PCN, some restrictions (on operating weight and/or frequencies) may apply. What DO change are the procedures for determining the ACR and PCR: Now based on rational models allowing the calculation of pavement responses (stresses, strains, deflections) from Layered Elastic Analysis (LEA). Pavement damage is then quantified based on these responses and a specific damage model.

1.4 In practical terms, the ACR-PCR method will lead to: New ACR values (calculated and published by aircraft manufacturers) – Still computed based on the combined result of aircraft wheel loads, tire pressures and landing gear geometry. New PCR values (calculated and published by airports) – Reporting format (one letter and a series of four letters) is unchanged – A model procedure for PCR determination is provided by ICAO (filling the lack of ICAO guidance for PCN evaluation), it can be parameterized to handle national or local specificities (e.g. subgrade failure model) – The PCR is computed based on the accumulated pavement damage produced by entire traffic mix (CDF) – Subgrade are now characterized by the elastic modulus E for both flexible and rigid pavements (unified characterization); Unchanged general approach (comparison of ACR and PCR).

1.5 Both ACR and PCR numerical values are approximately one order of magnitude (10x) higher than the ACN and PCN number. However, there is no ability to convert between ACN and ACR, nor between PCN and PCR. A new approach for overload operations (i.e. when ACR > PCR) –"ICAO allowance" is increased to 10% of the PCR for both flexible and rigid pavements –

1.6 Overloads in excess of 10% may be allowed if justified through a technical analysis of the impact on pavement damage, consistent with the PCR philosophy.

2. DISCUSSION

Determination of PCR values for national airports "using aircraft experience" method

2.1 Pakistan has adopted amendment 15 to ICAO Annex-14 with no differences filed at that time (20th July-2020). In nexus, since July 2020, plan for the adoption of new strength rating system ACR-PCR system was laid down keeping in view its applicability date of 28th November 2024 in order to comply with article 37 of Chicago convention to which Pakistan is co-signatory.

2.2 Currently Pakistan has nineteen (19) certified airports with fifteen (15) international and four (04) domestic airports. The old pavement rating system i.e. ACN-PCN which was implemented at these airports was mostly evaluated using "technical evaluation method" in 1990 to 2010 era. Most of the technical evaluation was carried out by third party i.e. technical consultants. However few pavements (Taxiways system) of these airports were evaluated using aircraft experience due to lack of knowledge of pavement materials properties and pavement sections details.

2.3 A committee consists of civil engineers in airports authority were constituted with the task of transition from old ACN-PCN to new ACR-PCR pavement rating system. The committee gathered data from airport operators in respect of most demanding aircraft which is operating on the aerodrome with sufficient number of operations. The following methodology were adopted for using aircraft experience method:

2.3.1 Determine the aircraft fleet operating on given airport and its corresponding number of departures.

2.3.2 Determine the sub-grade category (Note: ACR-PCR system employs modulus of elasticity of sub-grade rather than CBR, however methodology for conversion from CBR to elasticity is provided in ICAO Doc 9157 Part-3)

2.3.3 Use ICAO-ACR tool to compute the ACR values for each aircraft against the sub-grade of the pavement and tyre pressure code.

2.3.4 Identify the critical aircraft (aircraft with highest ACR value on the given sub-grade).

2.3.5 Assign the ACR of most demanding aircraft as PCR keeping in view the fact that the loading of this aircraft is not inadvertently affecting pavement structure.

2.3.6 Publish the PCR in State AIP.

2.4 The committee evaluated each airport's traffic and analyzed the traffic using ICAO-ACR software to determine the ACR of most demanding aircraft and publish the same ACR as PCR of the pavement. The relevant portions of Islamabad airport (OPIS) AIP in respect to new strength ratings of PCR is appended below for information usage only;

OPIS AD 2.8 APRONS TAXIWAYS AND CHECK LOCATIONS DATA

1. Apron surface and strength	Maintenance Apron: OTHER PCR 426/F/C/X/U
	NW Apron: Concrete PCR 1178/R/C/M/U
	SE Apron: Concrete PCR 1178/R/C/M/U
	State Apron: OTHER PCR 426/F/C/X/U
	Cargo Apron: Concrete PCR 1178/R/C/M/U
2. Taxiway width, surface and strength	Taxiway A : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway B : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway C : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway D : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway E : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway F : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway G : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway H : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway J : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway K : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway L : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway M : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway N : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway P : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway Q : 25 M ASPH, PCR 786/F/C/X/U.
	Taxiway R : 23 M ASPH, PCR 786/F/C/X/U.
	Taxiway S : 32 M ASPH, PCR 786/F/C/X/U.
	Taxiway T : 25 M ASPH, PCR 786/F/C/X/U.

OPIS AD 2.12 RUNWAY PHYSICAL CHARACTERISTICS

Designations RWY NR	True bearing	Dimensions of RWY (M)	Strength (PCR) and surface of RWY and SWY	THR coordinates	THR elevation and highest elevation of TDZ of precision APP RWY	Slope of RWY/SWY
1	2	3	4	5	6	7
10R	100.58°	3658 x 60	786/F/C/X/U ASPH Flexible	333304.28N 0724821.81E	THR 528.06 M / 1732.49 FT	0.12% UP
28L	280.60°	3658 x 60	786/F/C/X/U ASPH Flexible	333242.42N 0725041.37E	THR 532.53 M / 1747.14 FT	0.12% DOWN
10L	100.58°	3658 x 45	786/F/C/X/U ASPH Flexible	333310.98N 0724823.30E	THR 529.03 M / 1735.67 FT	0.12% UP
28R	280.60°	3658 x 45	786/F/C/X/U ASPH Flexible	333249.12N 0725042.87E	THR 533.41 M / 1750.04 FT	0.12% DOWN

3. CHALLENGES FACED: -

3.1 Following challenges were faced by committee while evaluating the PCR using aircraft experience method:

3.1.1 Challenges in timely imparting relevant training on ACR-PCR rating system.

3.1.2 Determination of most critical aircraft as in the most airports, the aircraft having highest ACR on given subgrade is not frequently operating and there is great chance that inaccurate strength of pavement is determined.

3.1.3 Insufficient data of pavement classification index (PCI) with aerodrome operators which indicates that pavement is sufficiently performing "satisfactory" under the "most demanding aircraft".

3.1.4 Constant surveillance of airport pavements by conducting more frequent PCI surveys to determine whether "reported PCR" is adequately reported against the loading of most demanding aircraft's ACR.

4. TRANSFORMATION TOWARDS "TECHNICAL EVALUATION METHOD:

4.1 In accordance with ICAO guidance, the use of the **"aircraft experience method"** for assessing pavement strength is discouraged on a long-term basis due to its inherent limitations and inability to accurately represent the true structural capacity of the pavement. Paragraph 1.4.6.3 of ICAO Doc 9157, Part 3, explicitly states that **"whenever possible, reported pavement strength should be based on a technical evaluation.** When, for economic or other reasons, a technical evaluation is not feasible, evaluation can be based on experience with using aircraft**."** In light of this

guidance, and to ensure alignment with international best practices, the Pakistan Civil Aviation Authority (PCAA) has directed all aerodrome operators to transition to the technical evaluation method for pavement strength assessment. **This transition is to be completed by January 2028.** Adopting the technical evaluation method will provide a more accurate depiction of pavement strength, thereby benefiting both **airline operators and aerodrome authorities** by enabling more informed decisions regarding aircraft operations and infrastructure management.

5. ACTION BY THE MEETING

5.1 The meeting is invited to:

a) Note the information contained in this paper;

b) Share member State's experience (aerodrome operators and regulators) regarding implementation of ACR/PCR; and

c) Discuss any other relevant matter on the subject by APAC states.

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