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Overview of ICAO Airport Pavement Strength Rating – New concept of ACR/PCR

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The need for change

The ACN-PCN method is based on **empirical** methods originally developed in the late 1930s and 1940s!

These methods have the following deficiencies:

- Overly conservative
- Unable to consider accurately “complex” landing gear configurations
- Unable to account for the improved characteristics of new-generation pavement materials
- Unable to consider the variability of landing gear transverse positions (different overall wheel tracks)
- The lack of guidance for PCN determination
- The former empirical methods are gradually being replaced by **mechanistic-empirical** methods for pavement design (based on analytical models: Linear Elastic Analysis or Finite Element Models)

➔ The ACN-PCN method is **inconsistent with modern pavement design methods**

Development process of ACR-PCR method

- The ACR-PCR method was finalized by the APEG beginning of 2018, followed by the full ICAO review & adoption process:
  - Aerodrome Design and Operations Panel (ADOP) adoption in March 2018
  - Air Navigation Commission (ANC) preliminary adoption in November 2018, final adoption (after consultation with States) in June 2019
  - ICAO Council adoption (amendment 15 to Annex 14) in March 2020
- The ACR-PCR method has been **effective** since July 2020:
  - Aircraft manufacturers start publishing their ACR
  - Trainings for users (CAAs, airports, aircraft manufacturers) can be initiated
  - CAAs should implement the new ICAO standard into the national regulations
  - Airports can start implementing the new protocol
- The method will be fully **applicable** in November 2024:
  - Airports should have published their PCR

The Key Changes

- What **DOES NOT** change is the comparison of ACR and PCR as the core principle of the method:

  If ACR $\leq$ PCR, the aircraft can operate on the pavement without restriction

  If ACR > PCR, the aircraft may be excluded, or may be allowed to operate subject to weight and/or frequency limitations

- What **DO** change are the procedures / model for determining the ACR and PCR:
  - Now based on rational models allowing the calculation of pavement mechanical response (surface deflections, internal stresses, strains within the pavement) induced by surface traffic loads from Layered Elastic Analysis (LEA)
  - Pavement **damage** is then quantified based on on a specific damage model, using as an input these responses (especially strains for flexible pavements and stresses for rigid pavements)

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 number and a series of four letters) **is unchanged**
    - A generic procedure for PCR determination is provided by ICAO (addressing the lack of ICAO guidance for PCN evaluation). **The generic procedure is general enough to accommodate most national or local (e.g. the generic procedure does not specify a particular subgrade failure model) design procedure**
    - The PCR is computed based on the accumulated pavement damage produced by entire traffic mix **(CDF Concept)**
    - Subgrade are now characterized by the elastic modulus E for both flexible and rigid pavements (unified characterization)

Both ACR and PCR numerical values are approximately one order of magnitude (10x) higher than the ACN and PCN numbers

However, **there is no ability to convert between ACN and ACR, nor between PCN and PCR**

NEW Provisions on Overload Operations

- 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
  - 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

The detailed pavement analysis will perfectly predict the effect of the overload operation on the structural pavement service life

Benefits

- The ACR-PCR system overcomes the deficiencies of the ACN-PCN system and allows **consistency and alignment between pavement design and pavement rating systems**
- The new system enables an **optimized usage** (in terms of allowable aircraft weights and frequencies) of **existing and future pavements**, without excessive conservatism
- For **aircraft operators**, it should lead to **fewer pavement-induced weight restrictions**. (Local exceptions are possible.)
- For **airport operators**, it provides a consistent damage-based approach:
  - optimize the use of their pavements;
  - assess the impact of overload operations; and
  - improve pavement structural life predictions.
- For **aircraft manufacturers,** it will allow them to optimize landing gear geometry (both leg geometry and overall geometry) of their future products

Implementation support

Doc 9157 Part 3 - Pavements

- Third edition published in 2022 (unedited 2021)
- Includes new ACR/PCR methodology
- All ICAO languages except Russian
- State practices to be included by 2024

ICAO Training (ACR/PCR)

Detailed training

- Target audience:
  - Specialized airport engineers.
  - Consultants working on airport pavement design.
  - Specialized State CAA engineers
- In person & online
- Duration : 2 days

ICAO Training (ACR/PCR)

Overview training

- Target audience:
  - Airline flight operations staff.
  - Airport operations and management staff.
  - State CAA staff.
  - Airport consultants
  - Academic participants
- Only online
- Duration : 3 – 4 hours

- ICAO aims to enhance awareness in the industry and promote cooperation between counterparts in terms of pavement related issues.
- ACR/PCR regional webinars.
- Training and implementation support.

Thank you!